POLICY BRIEF 2022

Effects of Urban Effluent-Contaminated River Water on Male Reproduction

Extracted from a Research conducted by:

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Executive Summary

Contamination of water in urban rivers with industrial, domestic and sewage effluent is a common feature especially in developing and underdeveloped countries. In these countries, human habitation along these rivers often results in slum dwellings of low-income earning and poor households. Water being an essential commodity to humans and animals, these households often use the only readily available water to them, which is drawn from effluent-contaminated urban rivers for their domestic consumption and for crop and animal farming purposes. However, recent controlled research on male piglets raised in these households and regularly given the effluent-polluted river water to drink has found adverse effects on their testicular structures, which would hinder normal reproduction (Kipyegon *et al*., 2017). The reason for this is the presence of some chemicals in effluent-polluted river water, which have been shown to disrupt endocrine functions and reproductive hormone production in the body (Kolpin *et al*., 2002). These chemicals can get into the human body directly by consuming this effluent-contaminated water or indirectly from animal products of animals that drink this water or crops especially vegetables watered from these polluted rivers. This policy brief proposes the introduction of regulations to control discharge of effluent into the rivers whose water is likely to be utilized for domestic consumption as well as for animal and crop farming.

Introduction

Waste effluent in cities and urban centres of developing countries inevitably drains into rivers that flow in close proximity to these centres. Dense population in the cities and urban centres has a large proportion of low earning and jobless people who inhabit underdeveloped poor locations often along these rivers in village-like slums. Waste effluent are reported to contain with endocrine-disrupting chemicals, which end up contaminating the urban draining rivers (Kolpin *et al*., 2002). Animals that have regular access to water from the effluent-contaminated water were found to have adverse reproductive defects (Kipyegon *et al*., 2017). The main source of pollution in river

water for urban and densely populated peri-urban areas is the discharge from sewage treatment works, industries, farmlands and informal settlements close to the river (Sibanda *et al*., 2015).

Residents of overpopulated peri-urban settlements use untreated sewage-contaminated urban river water for urban agriculture especially to grow vegetables and raise livestock such as pigs and poultry. For example, 30% of Nairobi residents raise livestock and cultivate food crops, especially vegetables along river banks using untreated sewage-contaminated water (Karanja *et al*., 2009) (Figure 1).

Figure 1: Sections of Nairobi River showing: (**A**)- Contamination and Slum structures; (**B**)- Young pigs from some the slum homes scavenging along the polluted river and drinking the polluted river water.

The study

The study was prompted by the immense habitation as well as smallholder vegetable and food animal farming along the Nairobi river and other urban rivers in the greater Nairobi metropolitan Sub-Counties. The objective of the study was to determine possible effects of effluent-polluted water on the gonads in boars (*Sus scrofa domestica*) that would affect their reproductive performance. This was attained by examining the histopathology of testicular tissue from boars that have constantly drank effluent-polluted river water.The other objective was to determine possible presence of chemicals in this effluent-polluted water that would have a negative effect on reproduction of the boar. This was attained by laboratory analysis of water from an urban effluent-polluted river.

The findings in the testicular tissue of domestic pigs can be extrapolated to man owing to their genomic similarity to man. This would imply possibility that any risk to reproduction in the boar from effluent-polluted water would also be a possible risk to reproduction in man. Exposure of man to effluent-polluted water chemical-contaminants can be indirect through consumption of meat from animals that have constantly drank this water or vegetables irrigated with water from effluent-polluted rivers. Previous findings reported that boys from habitations in the vicinity of harzadous was disposal sites had reproductive abnormalities (Svechnikov *et al*., 2014).

Findings

Significant number of male piglets born from sows fed with river water containing endocrine-disrupting chemicals (EDCs) had one or both testicles that did not descend from the abdomen during embryonic formation (Mutembei *et al*., 2017). Histological examination of the testis of males that were reared drinking EDCs contaminated river water, revealed changes that would lead to reduced or failed fertility. These histological changes included vacuoles in the epithelium of seminiferous tubules, sloughing-off of spermatozoa germ cells and depletion of the seminiferous epithelium (Kipyegon *et al*., 2016a and 2016b; Figure. 2). These effects were dependent on both EDC toxicity level and the duration of consumption (Mutembei *et al*., 2017).

The main EDCs isolated in the contaminated river water were estradiol and estrogen-like compounds (Kipyegon *et al*., 2016). It has been demonstrated previously that these compounds cause infertility and are capable of accumulating along food carbon chain to affect unsuspecting consumers (Sharpe and Irvine, 2004). Part of the food chain involves direct and indirect consumption of meat and their products respectively, from pigs raised with EDCs contaminated river water.

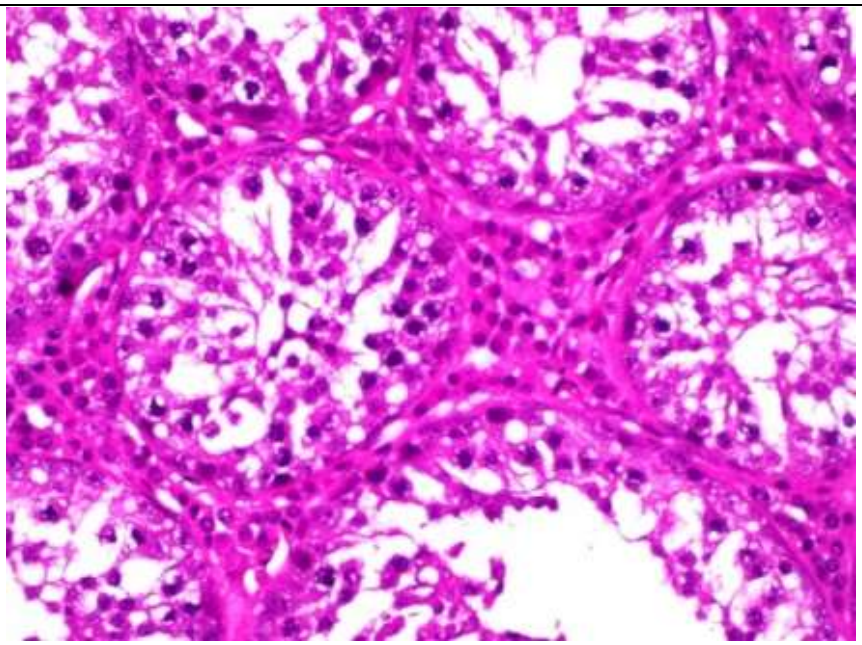

Figure 2: Photomicrograph of the testis of a boar that was kept on EDCs contaminated river water, showing germ cell desquamation and displacement with an increase in the intra-epithelial empty spaces (Magnification×400 H&E stain).

In the sampled sections of the urban streams, the concentration of alkyl phenol ranged from 0.08 to 0.9174 µg/L whereas those of 17β-estradiol ranged from between BDL to 0.3005 µg/L. Of the two compounds tested, alkyl phenol had the highest significant concentration (0.9174 µg/L; $P \leq 0.05$. The mean values were 0.0953 µg/L and 0.360 µg/L for 17β steroid and alkylphenol, respectively (Kipyegon *et al.*, 2016). Whenever detected, the levels were significantly higher than the levels of estrogen-like compounds known to cause detrimental effects (Aerni *et al*., 2004), which are enough levels to cause reproductive dysfunctions such as retained testes (cryptorchidism) and/or destructive histopathologic changes of the testicular tissues.

Thus, the results validated the hypothesis that, indeed the observed changes in the boars, were caused by the EDCs in the waste-polluted water of urban rivers such as Nairobi river (Kipyegon *et al*., 2016). These effects could gradually affect man through direct consumption of the water or indirect means by consuming vegetables irrigated with this water or meat from animals reared using this water.

Policy recommendations

Proposed that regulations be made to:

1. Prohibit direct discharge of waste effluent-polluted water from households, farming activities or industries into urban streams and rivers.

2. Prohibit the use of waste effluent-polluted water for both animal and crop farming activities.
3. Educate and warn consumers on the dangers posed by consuming this water food items produced using waste effluent-polluted water.
4. Sensitize counties to provide purified water and approved sewage waste disposal methods to the urban informal settlements for prevention against dangers of EDCs.

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