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Histological effects of chronic consumption of soda pop drinks on kidney of adult Wister rats

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Abstract

Background: Health concerns over soda pop drinks have been severally report. However, histological perspectives are not very common. **Aim:** The objective of this study is to investigate histological effect of chronic consumption of soda pop drinks on the kidney of adult Wistar rats. **Materials and methods**: The rats of both sexes (n = 24), with average weight of 200g were randomly assigned into two treatment (A & B) (n=16) and Control (c) (n=8) groups. The rats in the treatment group (A) received a brand of soda pop drink on a daily basis for thirty days. The rats in treatment group (B) received another brand of soda drink, while the control group (C) received equal amount of water for the same period. The rats were given the drinks as well as feeds liberally for thirty days, and sacrificed by cervical dislocation on the thirty-first day of the experiment. The kidney was carefully dissected out and quickly fixed in 10% formal saline for histological study. **Results**: The findings indicate that rats in the treated groups (A&B) showed some varying degree of distortion and disruption of the renal structure. There are observable diffuse signs of glomerulonephritis with some congestion and tubular necrosis as compared to the control group. **Conclusion**: Chronic consumption of soda pop drinks may affect the microanatomy of the kidney of adult Wistar rats. Further study aimed at corroborating these observations in humans is warranted.

Keywords: Histological effects, kidney, soda pop drinks, Wistar rats.

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Introduction

Soda pop drinks are carbonated non-alcoholic soft drinks with a sweet bubbly refreshing taste. They are commonly referred to as soda pop and contain mainly water, sugar and chemicals in the form of colorings, flavors, preservatives and sweeteners. The rate of consumption of these drinks is alarming especially in the affluent countries. For instance, the average Australian and about 63% of Irish children consume an estimate of one canned drink of 375mL per day [1, 2]. In Nigeria, study has shown that more than 70% of babies are given soft drinks [3], including Coca-cola, Pepsi-cola, and Seven-Up to name a few.

Most people view soft drink consumption as fairly innocuous. However, there is a number of serious health issues associated with regular consumption of soft drinks. One peer-reviewed study has reported 25 separate harmful effects associated with the consumption of carbonated soft drinks [4]. There is a speculated link between the consumption of sugar-sweetened soft drinks and development of cardiovascular disease, diabetes mellitus, dental/bone problems and obesity [5-8], all of which are strongly associated with kidney health. There is also the associated risk of formation of kidney stones [9].

However, research reports relating directly to the effects of soda pop drinks on the kidney have yet to be well covered. Therefore, the impact of soda drinks on renal health is as yet hypothetical speculations and actual evidence is lacking. The kidney is an organ whose functions include the removal of waste metabolic products from the blood as

well as regulation of water and electrolytes balance in the body. Since the kidney is involved in the excretion of many toxic metabolic waste products, and given the rate of soft drink consumption amongst youths and casual workers, it would be worthwhile to examine the effects of soda pop drinks consumption on the kidney in order to observe any possible evidence.

Materials and Methods

Animal care ethics

The School of Basic Medical Sciences, University of Benin grant approval before the work begins. The rats were obtained and maintained in the Animal Holdings of the Department of Anatomy, School of Basic Medical Sciences, University of Benin, Benin city, Edo State, Nigeria. The animals were fed with grower's mash obtained from Edo Feeds and Flour Mill Limited, Ewu, Edo State, Nigeria and given feeds liberally. Two brands of soda pop drinks herein de-identified and coded as [brand A] and [brand B] were sourced in Benin City, Edo State, Nigeria.

Soda pop drinks administration

Twenty-four adult Wistar rats of both sexes with average weight of 200g were randomly assigned into three groups: A, B and C of eight per group. Group A and B served as treatment groups while group C served as the control. The rats in group A, B and C were respectively given [brand A], [brand B] and water liberally. That is, the drinks were always there for the animals, but usually changed daily for a fresh one after cleaning the container. The rats were sacrificed by cervical dislocation on the thirty-first day of the experiment. The abdominal region was quickly opened and the kidney dissected out and fixed in 10% formal saline for routine histological techniques.

Histological study

The tissues were dehydrated in an ascending grade of alcohol (ethanol), cleared in xylene and embedded in paraffin wax. Serial sections of 7 microns thick were obtained using a rotary microtome. The deparaffinized sections were stained routinely with haematoxyline and eosin (H & E). Photomicrographs of the results were obtained using research photographic microscope in the Department of Anatomy, School of Basic Medical Sciences, University of Benin, Benin city, Edo State, Nigeria.

Results

The photomicrograph of the kidney in the control group (C) showed normal histological features. The section indicated a detailed cortical parenchyma and the renal corpuscles appeared as dense rounded structures with the glomerulus surrounded by a narrow Bowman's spaces.

The kidney section of the animals in the treated groups (A & B) revealed some varying degree of distortion and disruption of the cytoarchitecture of the renal cortex, diffuse glomerulonephritis with some congestion and tubular necrosis as compared to the control group. The distortions on the treated sections appear more remarkable in the [brand B] sections (Fig. 3) compared to the [brand A] sections (Fig. 2).

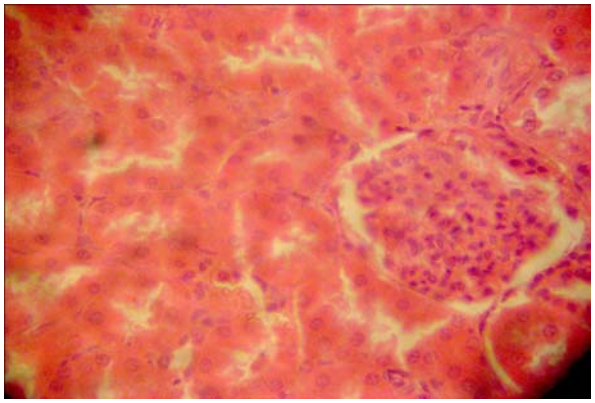

Fig. 1 Control section of the Kidney (H & E, x400). Stained section of kidney obtained from one of the Wistar rats in the control group (C).

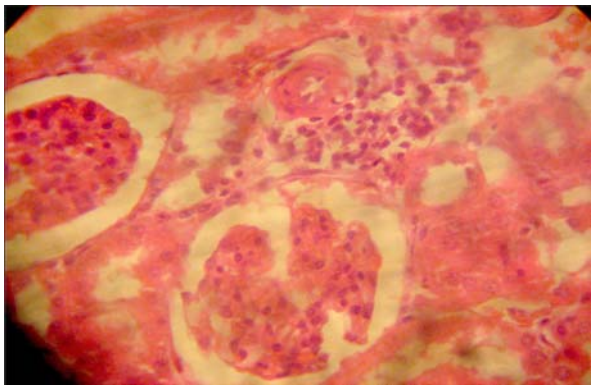

Fig. 2 Treated kidney with [brand A] soda pop drink (H & E, x400). Stained section of kidney obtained from one of the Wistar rats in the group (A).

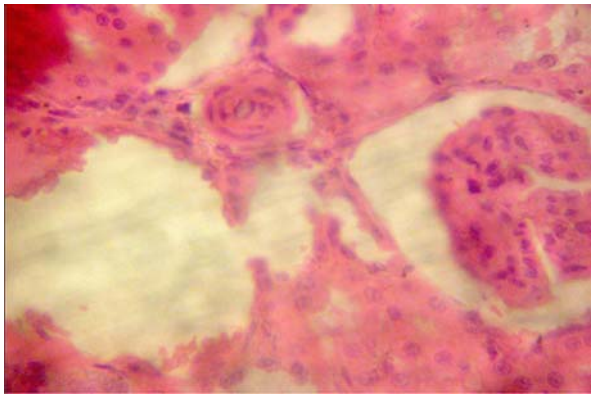

Fig. 3 Treated kidney with [brand B] soda pop drink (H & E, x400). Stained section of kidney obtained from one of the Wistar rats in the group (B).

Discussion

The study revealed that chronic consumption of soda pop drinks resulted to some varying degree of distortion and disruption of the cytoarchitecture of the renal cortex, diffuse glomerulonephritis with some congestion and tubular necrosis as compared to the control group. The

result obtained in this experiment is probably due to the chronic consumption of the soda drinks on the kidney with that of the [brand B] appearing more remarkable. It demonstrates that soda drink consumption may not be as harmless as generally believed. We hypothesize that the structural changes in the kidney observed in this experiment could be associated with functional changes that may be detrimental to the health status of the animals.

The result obtained in this experiment is in consonance with, and continuation of the work carried out by Enaibe *et al*. They reported that administration of camphor resulted in mild edema with glomerulonephritis, glomerular lobulation, tubular necrosis and congestion of blood cell in the kidney of rabbit [10]. Administration of damiana (Turnera diffusa) to matured Wistar rats resulted in the distortion of the renal cortical structures, reduced size and number of the renal corpuscles and some degree of cellular necrosis in the histology of the kidney [11].

These findings implicate soda pop drinks as capable of precipitating kidney disease probably by causing congestion and tubular necrosis of the kidney. Pathological or accidental cell death is regarded necrotic and could result from extrinsic insult to the cell as osmotic, thermal, toxic and traumatic effects [12]. The process of cellular necrosis involves disruption of membranes, as well as structural and functional integrity. Cellular necrosis is not induced by stimuli intrinsic to the cells as in programmed cell death, but by an abrupt environmental perturbation and departure from the normal physiological conditions [13]. In this experiment, the soda drinks may have acted as toxin to the cells of the kidney resulting in the distortion and disruption, congestion and glomerulonephritis.

This study has not looked into the mechanism of renal damage. The report is limited simply to a general statement about the overall architecture of the tissue. Consumption of carbonated soft drinks has been implicated in several diseases including cardiology, diabetes, and renal calculi [4-8]. What this report adds to the literature is the perspective of the microanatomy of the kidney. The hypothesis of possible functional changes that may be detrimental to the health status of the animals would require further studies, including quantification of the structural changes as well as urine and microscopic examinations.

Conclusion

Our study revealed that chronic consumption of soda pop drinks could result in the distortion and disruption of the microanatomy of the kidney. It is probable that the function of the kidney may be adversely affected. It is recommended that further studies aimed at corroborating these findings be carried out.

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