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Effects of white vinegar on Carbohydrate Contents in Hepatorenal Tissues in Rats.

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ABSTRACT

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White vinegar is mildly acidic with a pH of 2-3 that has long been used as a relish and traditional medication that depends on its concentration. Yet even a small amount of white vinegar in a small concentration may cause serious poisoning. Recently, many sorts of white vinegar have been developed using fundamental sources and technologies to satisfy customer needs. This study was aimed to investigate the effects of white vinegar on carbohydrate contents in hepatorenal tissues in rats. Thirty female rats were used, they were divided into three groups, group 1 was given distilled water as the normal control group, group 2 was given white vinegar with a dose (1 ml/kg (5 %)) and group 3 was given white vinegar with a dose (1 ml/kg (10 %)) for two weeks. PAS stain in all treated tissues showed a decrease in carbohydrate contents when compared with the control group. In conclusion, white vinegar consumption has adverse effects on carbohydrate contents in hepatic and renal tissues in rats, hence the quantity of white vinegar should be discouraged or reduced.

1 Introduction

The liver is affected by hazardous substances, exhibiting different degrees of toxicity. In chronic liver injury, the injured cells release a number of cytokines and stimulate the Kupffer cells to release more inflammatory mediators and various free radicals. Massive reactive oxygen species (ROS) production in the hepatic tissue induce oxidative stress, moreover, oxidative stress can induce many kinds of negative effects including membrane peroxidation, protein cleavage, and deoxyribonucleic acid (DNA) strand breakages, which could lead to cancer (Eid et al., 2015). Moreover, the kidney as the excretory and filtration unit of the body is highly exposed to the heavy free radical load and therefore may lead to various anomalies in the normal functioning of its own physiology (Nakhaee et al., 2009).

The cell membrane which is typically selectively permeable, now becomes permeable to any molecule, because of the free radicals (ROS and other reactive species) leading to much oxidative cellular damage of

the cell membrane. Such damage to the cell membrane changes the functions of the cells and ultimately affects the internal cellular environment and finally leading to cellular death (Dröge, 2000). Furthermore, the chain of free radicals generated from cells weakens/down-regulates the antioxidative enzyme system thus making it unable to scavenge them. Glutathione reduced (GSH) which is the primary antioxidant system plays a crucial role in the defense of cells from reactive free radicals and other oxidants species. Further, superoxide dismutase (SOD), catalase (CAT) are powerful antioxidant molecules that always remain active during their reduced state in order to be compatible to scavenge free radicals (Seghrouchni et al., (2002) and Rai and Halder, (2003).

White vinegar (WV), the volatile organic acid that identifies the product as white vinegar consists of about 3 to 10 % of acetic acid content and is responsible for the tart flavor and pungent, biting odor of kinds of white vinegar (Mahmoodi et al., 2013). Moreover, the etiology of white vinegar-induced ulcers mimics human gastric and duodenal ulcers in location, chronicity, and severity (Okabe and Amagase, 2005). WV is absorbed from the

gastrointestinal tract and through the lungs and almost completely oxidized by tissues. The metabolic pathways are reasonably well identified and include the formation of ketone bodies. The toxic effects of white vinegar are due to irritant properties as well as its effect on the central nervous system and kidneys (Chibishev et al., 2013). However, foods such as sushi and marinated meats and vegetables that are prepared with white vinegar contain 0.2-1.5 g of acetic acid/100 g. WV is also used traditionally as folk medicine and is believed to have several effects such as improving appetite. Also, it was shown that a diet containing vinegar at a dietary concentration of 1.6 ml white vinegar/100 g/diet (Fushimi et al., 2001). Various literature supports heavy free radical production and physiological stress as a major causative agent of white vinegar. Such physiological stresses during the white vinegar condition may impair renal functions due to hyperproduction of urea, uric acid, and creatinine in the blood serum which constitutes the basic parameters for renal function analysis (Thérond et al., 2000). This study was aimed to investigate the effects of white vinegar on carbohydrate contents in hepatorenal tissues in rats.

2 Materials and Methods

2.1 The chemicals:

White vinegar (WV) was obtained from the Omar Al-Mokhtar University. Animals were given white vinegar orally by gavage at a dose of 1 ml/ kg/ body weight/ day (Pastrelo et al., 2017) for two weeks. WV was given to animals in this study at two concentrations:

- Rats were given (5% of WV) according to Soykan et al., (2015).

- Rats were given (10% of WV) according to Souza et al., (2007).

2.2 Experimental animals:

Healthy female albino rats (*Rattus norvegicus*) with an average weight of 180-225 g. Animals were obtained from the animal house of the Zoology Department, Faculty Science, University of Omar Al-Mokhtar, El-Beida, Libya. All animals were allowed 3 weeks per experimentation period to acclimatize to laboratory conditions in order to avoid any complications along the course of the experiment. They were housed in cages at room temperature. Rats were fed with a laboratory diet and water ad libitum with fresh daily supplies.

2.3 Experimental design:

A total of 30 female albino rats were used. All rats were abstained from food for 24 hours with given the water ad libitum prior to the experimental procedures then they were randomized into three groups 10 rats in each:

- Normal control group: Rats were given orally distilled water for two weeks
- Treated group: Rats were given orally WV (5%) by gavage at a dose of 1 ml/kg/b. w./day for two weeks.
- Treated group: Rats were given orally WV (10%) by gavage at a dose of 1 ml/kg/b. w./day for two weeks. After the completion of treatment period, animals were sacrificed then the liver and kidney were removed.

2.4 Histochemical preparation:

The periodic acid Schiff's reaction (PAS), as applied for carbohydrate demonstration fixation was carried out in 10% neutral buffered formalin, paraffin section (5 µm thick) were brought down to water then placed in 1% periodic acid for 5 minutes, washed for minutes in running water, rinsed in distilled water and treated with Schiff's reagent for 20 minutes, section were then transferred through freshly prepared 0.5% sodium bisulfate for 3 changes, followed by 5 minutes in running tap water, dehydrated, cleared in xylol and mounted in Distyrene plasticizer xylene (DPX). The positive materials appeared pink (Drury and Wallington, 1980).

3 Results

3.1 Histochemical results:

The liver tissues:

The periodic acid Schiff reaction (PAS) in normal control rats in liver tissues, showed a very strong reaction among control liver sections (Figure.1). Whereas, female rats treated with 5% of white vinegar showed a weak or feeble stainability in the reaction of PAS in the carbohydrate contents among this group (Figure. 2), female rats treated with 10% of white vinegar showed a decrease in the reaction of PAS in the carbohydrate contents (Figure. 3), as compared with the control group

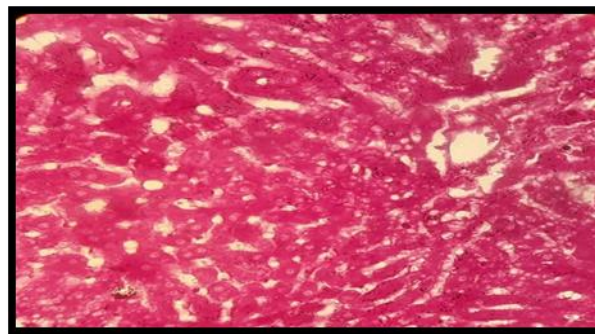


Figure 1: Photomicrographs of PAS-reacted liver section of normal control female rats showing, very strong normal reaction of carbohydrate granule contents (PAS stain, X40)

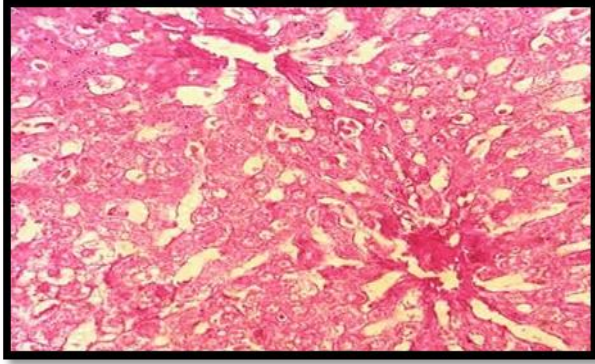


Figure 2: Photomicrographs of PAS-reacted liver section of female rats treated with WV 5% showing, a decrease in the reaction of PAS in the carbohydrate contents (PAS stain, X400).

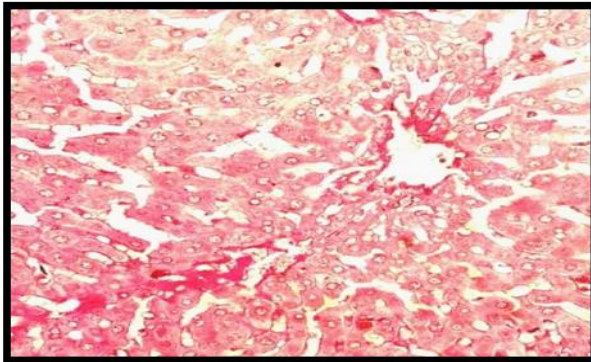


Figure 3: Photomicrographs of PAS-reacted liver section of female rats treated with WV 10% showing, showing, a weak or feeble stainability in the reaction of PAS in the carbohydrate contents (PAS stain, X400).

The kidney tissues:

The periodic acid Schiff reaction (PAS) in normal control in kidney tissues, showed a very strong reaction among control kidney sections (Figure. 4), along the basement membranes of the renal tubules, the parietal layer of Bowman's capsule and glomerular capillaries, and along the apical brush border of the proximal convoluted tubules (PCT), while, female rats treated with 5% of white vinegar showed the tubular epithelial cells appeared to be resting on their PAS-positive basement membrane and a PAS-positive reaction was noticed along the uninterrupted brush border of most PCTs (Figure. 5). While, female rats treated with 10% of white vinegar showed detachment of many tubular epithelial cells from their basement membrane and marked interruption in the PAS-positive reaction along the brush border of many PCTs (Figure. 6) that still less than that of the control group.

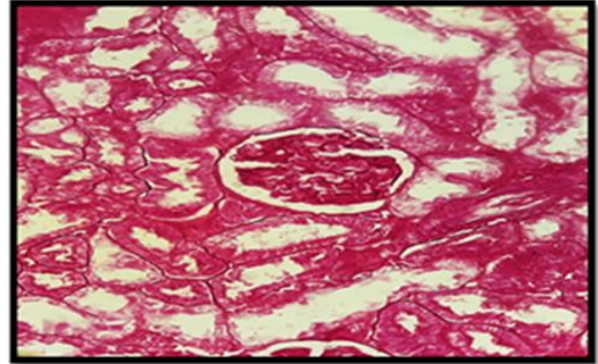


Figure 4: Photomicrographs of PAS-reacted kidney section of control female rats showing, a very strong reaction along the basement membranes of the renal tubules, the parietal layer of Bowman's capsule and glomerular capillaries, and along the apical brush border of the PCT (PAS stain, X400).

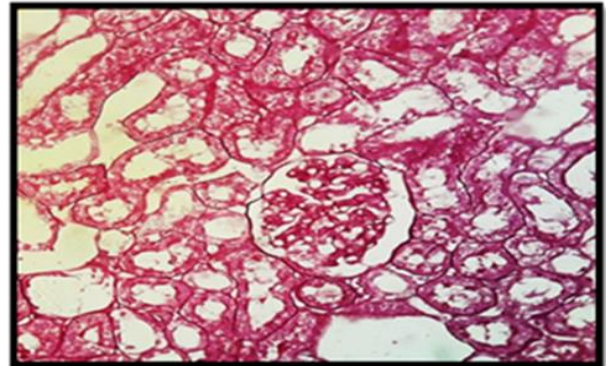


Figure 5: Photomicrographs of PAS-reacted kidney section of female rats treated with WV 5% showing, the tubular epithelial cells appeared to be resting on their PAS-positive basement membrane and along the uninterrupted brush border of most PCTs (PAS stain, X400).

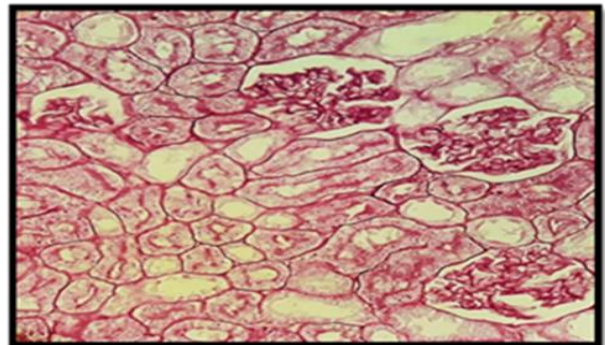


Figure 6: Photomicrographs of PAS-reacted kidney section of female rats treated with WV 10% showing, detachment of many tubular epithelial cells from their basement membrane and marked interruption in the PAS-positive reaction along the brush border of many PCTs (PAS stain, X400).

4 Discussion

Drugs or chemical-induce liver and kidney injuries have become a major clinical problem. The precise mechanisms underlying drug- or chemical-induced hepato-toxicity and nephrotoxicity are gradually elucidated. However, there is still a lack of effective therapeutic strategies or specific medicines for such diseases (Hasan *et al.*, 2016). The present study showed a decrease in carbohydrate content in the liver tissues as well as in kidney tissues following exposure to white vinegar in treated rats as compared to the control group that showed a very strong PAS reaction.

Al-Rouby and Gawish (2013) explained that the decreased carbohydrate content of hepatocytes after treatment with chemicals could be due to altering activities of various enzymes included in carbohydrate synthesis as well as decreased glucose reabsorption and increased disposal via urine. In addition, Granneman *et al.* (1984) mentioned that the major clearance route of drugs and their toxic metabolites is glucuronidation. Comprise of this metabolic route, directly or indirectly by situations in which carbohydrate is depleted. Furthermore, Glaumann *et al.* (1979) proved the uptake and degradation of carbohydrate by Kupffer cells. This might be a cause of carbohydrate depletion in liver cells and at the same time a cause for swelling of Kupffer cells. Another cause for Kupffer cell hypertrophy might be lipid deposition in their cytoplasm. Moreover, the reduced carbohydrate content in the current study indicated may be due to fatty degeneration in the liver of white vinegar groups, this event may have occurred as a result of oxidative damage in hepatocellular proteins, Abdellatif, (2013) has mentioned the same in his study or due to necrotic changes in hepatocytes.

On the other hand, Al-Hamdany and Al-Hubaity (2014) showed that the weak positive reaction of PAS in treated animals as compared to the control animals. This may be due to a depletion of the stored carbohydrates from the liver as a result of oxidative stress on the liver caused by the drugs and chemicals. A marked decrease in polysaccharides may be due to a reduction in cellular respiration as well as lower metabolic activity and reduced adenosine triphosphate (ATP). The dramatic effects of chemicals on polysaccharides may be attributed to what has been suggested before by Abd-Allah *et al.*, (2000) and Selvakumar *et al.*, (2005). These authors suggested that the breakdown of the polysaccharide may be attributed to phosphorylase enzyme or decrease in tricarboxylic acid cycle enzyme activities.

Kumar *et al.* (2004) reported that decreased ATP synthesis is frequently associated with both hypoxic and chemical toxic injury, added that high-energy phosphate is required for many synthetic and degradative processes including membranes transport, protein synthesis, lipogenesis, and reactions necessary for phospholipid

turnover. This is obviously present when PAS reaction decreased indicating lower metabolic activity appeared in the cortical cells especially the proximal convoluted tubules means that impaired intracellular energy in the form of ATP supported the metabolic activities.

5 Conclusion

White vinegar consumption has adverse effects on carbohydrate contents in hepatic and renal tissues in rats, hence the quantity of white vinegar should be discouraged or reduced.

Conflict of interest: The authors declare that there are no conflicts of interest

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