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STUDY OF TOXICOLOGICAL PATHOLOGY CHANGES OF SUGAR FEEDING FOR SIX MONTHS IN LABORATORY WHITE RAT

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ABSTRACT

The present investigation demonstrated the effect of sugar given ad-lib (instead of food) to treat group for six months on the histological structure of the liver, kidneys and pancreas tissues of adult male and female rats. The histopathological observation for treated group showed, diffuse vacuolation and degeneration of liver cells (hepatocytes) with hypertrophy of bile ducts, and vacuolation cortical tubules with atrophy some glomeruli in kidney, and degeneration and vacuolation of islet of Langerhans in pancreas. During the study showed nervous signs especially in the males and were very aggressive and there were death of some animals from treated group probably due to renal failure induced by sugar (high intake).

KEYWORDS: WHITE RAT, SUGAR & HISTOPATHOLOGY

INTRODUCTION

Simultaneously, there have been marked alterations in the types and amounts of food consumed. One of the most conspicuous dietary changes has been the very considerable rise in sugar intake. Some regard this change specifically as the factor most responsible for the increase in diabetes. In this review, the relationship between rises in sugar intake and prevalence of diabetes and the bearing of sugar intake on obesity are discussed [1]. On the other hand there is not enough evidence that a high intake of sugar specifically promotes the development of diabetes, but this does not imply that sugar intake is unimportant. Because of the high prevalence of obesity in some populations, restriction of sugar intake is as important as other dietary restrictions. Within the last century the prevalence and mortality rates of diabetes and other degenerative diseases have increased considerably [1&2]. Diabetes mellitus

(DM) is a common metabolic disorder marked by elevated blood glucose concentration and excretion of glucose in urine [3&4]. DM occurs either because of lack of insulin or the presence of factors that oppose the actions of insulin. The result of the insufficient action of insulin is an increase in blood glucose concentration higher than 160mg/dl which is above the normal value of 80-120mg/dl in humans [5]. Statistics have shown that about 10% of the world's population suffers from DM [6]. In the past, avoidance of sugar has been a major focus of nutritional advice for people with diabetes. However, sugars are an acceptable part of a healthy diet for those with diabetes, particularly sugars obtained from fruits, vegetables and dairy products. Up to 10% of total daily energy requirements may consist of added sugars, such as table sugar and sugar-sweetened products, without impairing glycemic control in people with type 1 or type 2 diabetes [7,8&9]. Foods containing sugars vary in nutritional value and physiological effects. For example, sucrose and orange juice have similar effects on blood glucose but contain different amounts of vitamins and minerals. Consuming whole fruits and fruit juices causes blood glucose concentrations to peak slightly earlier but fall more quickly than consuming an equivalent carbohydrate portion of white bread. This results in a lower the glycemic index {GI} for fruits and fruit juices than bread [10&11]. Because refined sucrose produces a lower blood glucose response than many refined starches, some sweetened breakfast cereals produce lower plasma glucose and insulin responses than equal carbohydrate portions of unsweetened cereals [12]. Thus, undue avoidance of foods containing simple sugars is not necessary. Generally, however, intake of added fructose, sucrose or high-fructose corn syrup in excess of 10% of energy should be avoided, since evidence suggests that this may increase serum triglycerides and/or LDL cholesterol in susceptible individuals [13]. According to the American Diabetes Association's guideline, a moderate amount of sugar can be incorporated in a healthy diet and sucrose and sucrose-containing food in diabetic individuals need not be restricted because of a concern about aggravating hyperglycemia [14]. However, different types of sugars may have variable metabolic effects on glycaemia (2–4) and the role of different sugars in the development of histopathological changes and type 2 diabetes is yet scarcely studied [15].

MATERIALS AND METHODS

Animals and design:

White rats of both sexes weighing between 200-250 gm were used for the experiment. They were separated into 2 groups (control and treat), each group consisting of 4 animals, 2 males and 2 females. Then be subjected from October to march 2012. Animals were housed in wire mesh cages under ambient light conditions, with sugar given ad-lib to treat group. They were acclimatized to captivity for at least two weeks prior to testing. Sugar as ad-lib for six months. The sugar was as ground or crystals administrated to each animal for six months. The animals were observed in their cages for clinical symptoms daily. After six months (the end of the experimental period) animals were killed; and autopsy had been done to histopathological technique procedure and stained using hematoxylene and eosin stains.

Preparation Organs for Histopathological slides:

Organs such as the liver, kidney, adrenal, pancreas, cardiac muscle and stomach were fixed into 10% formalin. The specimens were then embedded in paraffin, sectioned and stained with hematoxylin and eosin, as described by [16&17] before being evaluated by light microscopy (Olympus).

Microscopic examination:

After sacrificing the experimental animals tissue samples from various visceral organs which were fixed in 10% neutral buffer formalin, then paraffin blocks were made and cut on rotary microtome to make slides of five microns which were then stained with H&E. those sections were examined by light microscope (Olympus) to detect and describe any histopathologic changes induced by this substance intake (sugar).

RESULTS

Results of our experiment summarized by different histopathological lesions; these lesions varied form organ to another but were apparent and considerable in liver and other organs like kidney and pancreas showed different lesions.

Histological and Histopathological Observations:

Liver sections of control rats (group) showed normal histological structures of the hepatocytes, bile duct and central vein (Fig.1). The most significant treatment-related histopathological toxologic pathology changes were in the liver and those changes were varied from diffuse vacuolation of hepatocytes with congestion (Fig 2). On occasion those changes were associated with advanced degrees of septal fibrosis, periportal fibrosis and hypertrophy of bile ducts (Figs 3,4) also there were congestion, fibrosis and deposits of hemosiderin in macrophages as macrophages-laden hemosiderin (Figs 5,6). Furthermore, other toxic pathologic changes in other visceral organs and tissues were varied from varying degrees of dilatation of renal cortical tubules and vacuolation of glomeruli in kidney (Figs 7,8). In addition further histopathological changes in pancreas as degeneration and vacuolation of islet of langerhans (Figs 9,10). During the study showed nervous signs especially in the males and were very aggressive and there were death of some animals from treated group and microscopic lesions were detected as above in liver, kidney, and pancreas. Note: all sections were taken transversely or obliquely from visceral organs of both male and female.

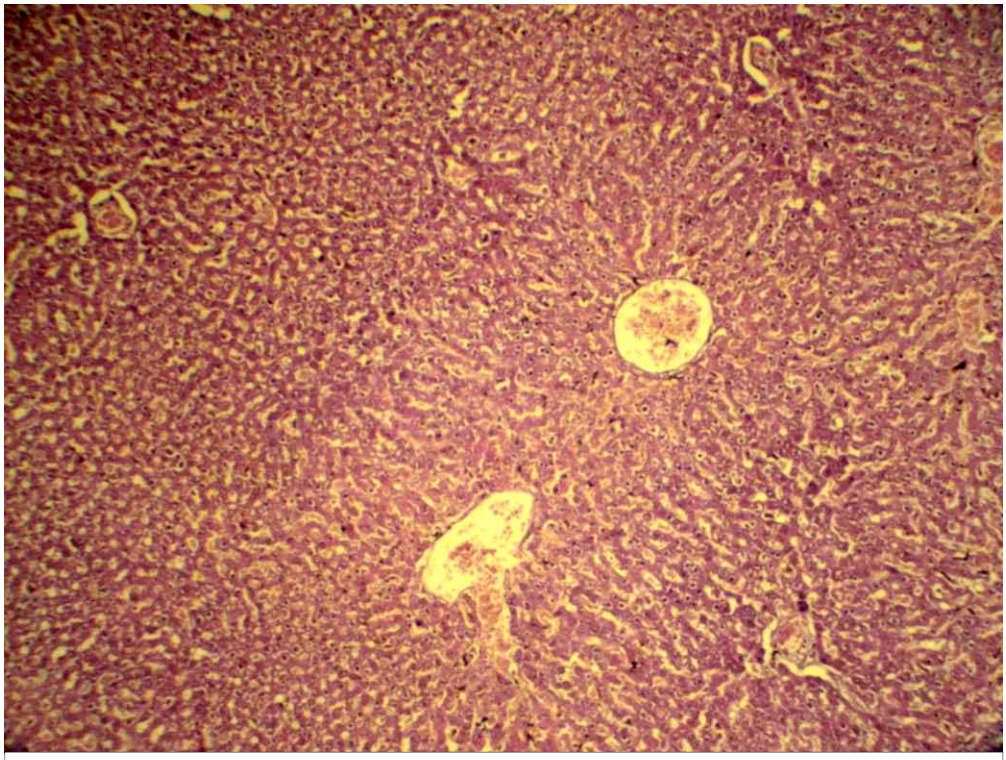

Fig (1): Liver; control, within normal limits.

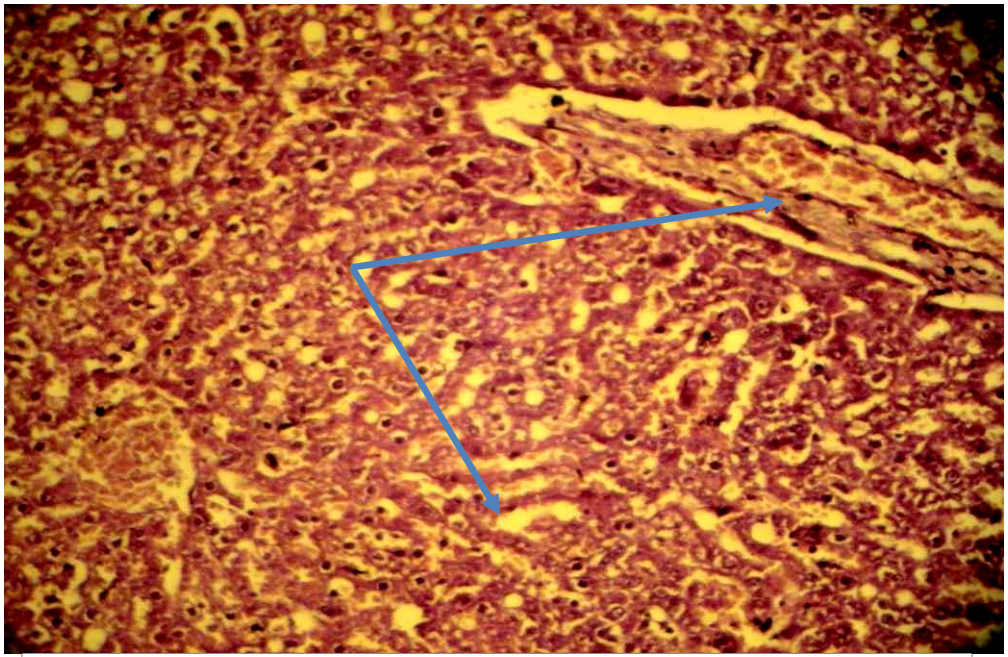

Fig (2): Liver; minimum diffuse vacuolation of hepatocytes with congestion.

(H & E,

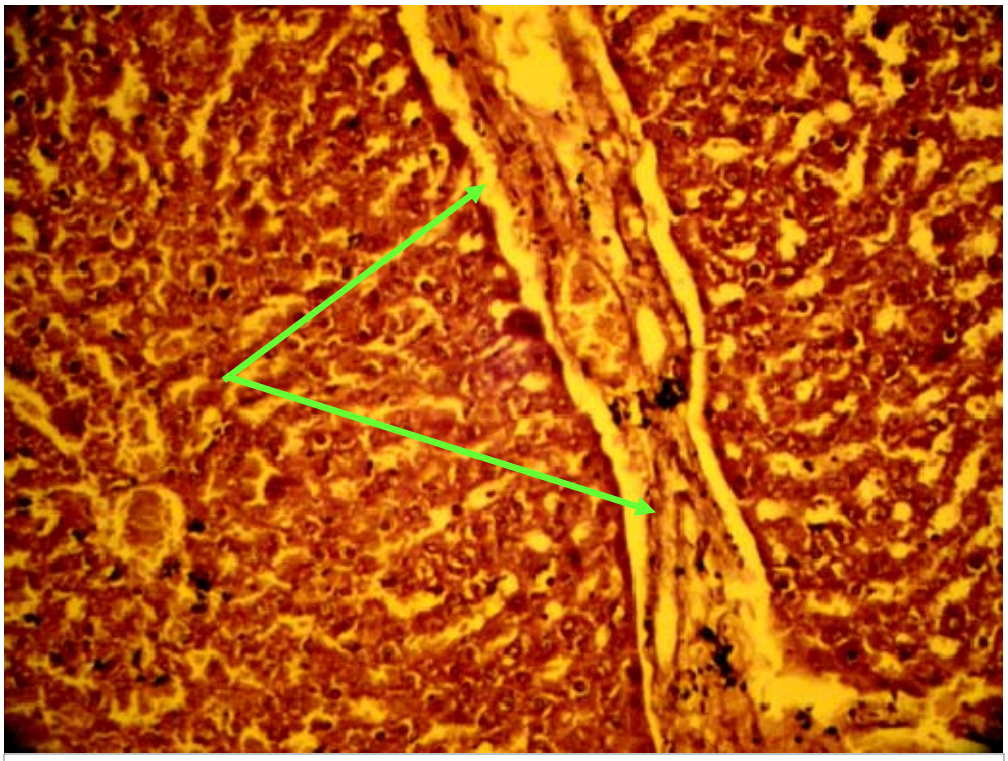

Fig (3): Liver; septal fibrosis and congestion.
(H & E, 10X)

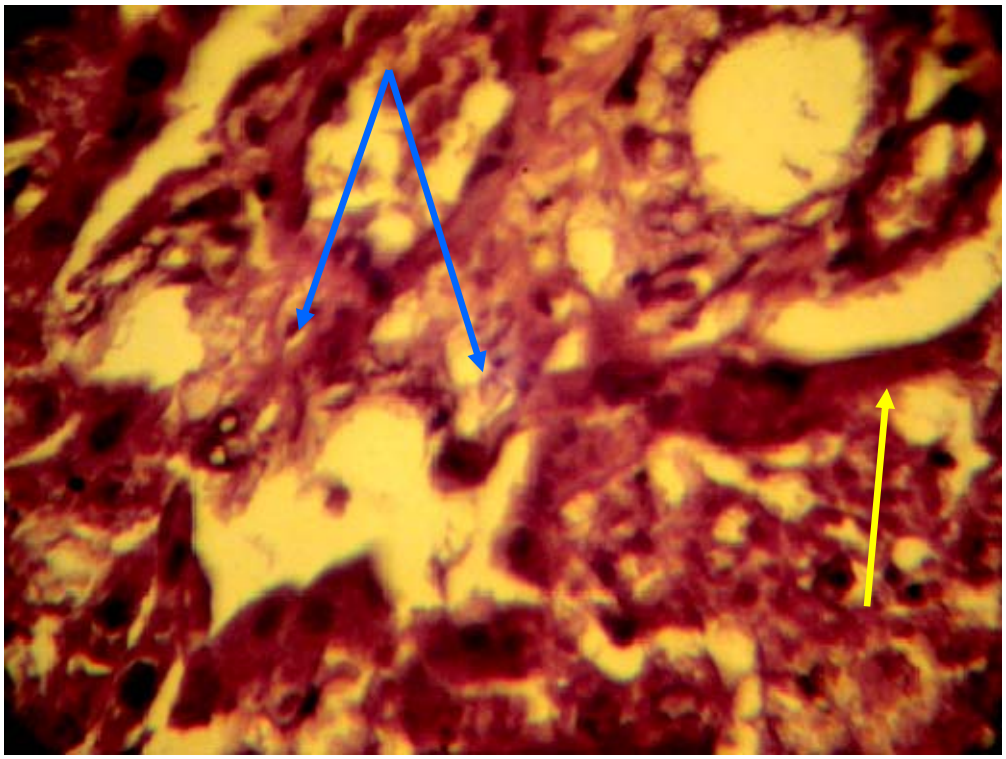

Fig (4): Liver; minimal preportal fibrosis and hypertrophy of bile duct.
(H & E, 40X)

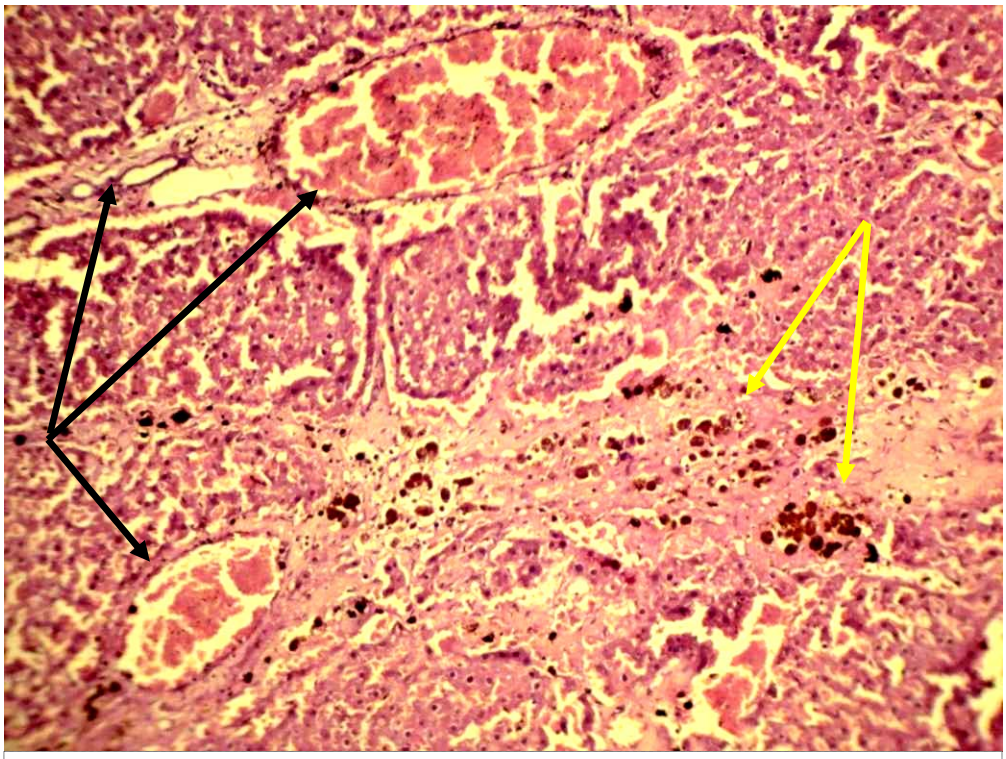

Fig (5): Liver; congestion and septal fibrosis also hemosiderin laden macrophages. (H & E, 10X)

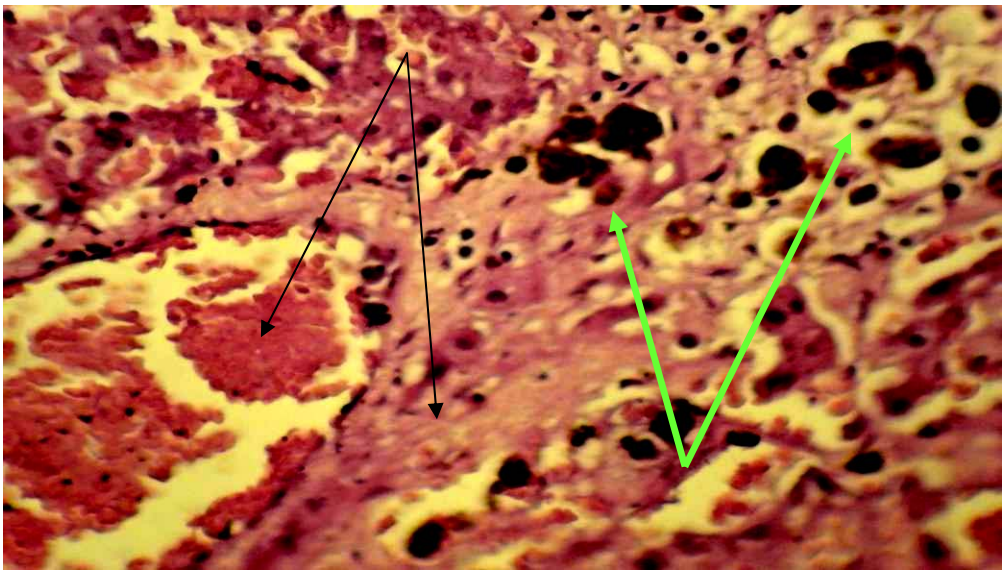

Fig (6): Liver; congestion and fibrosis also hemosiderin laden macrophages.

(H & E, 40x)

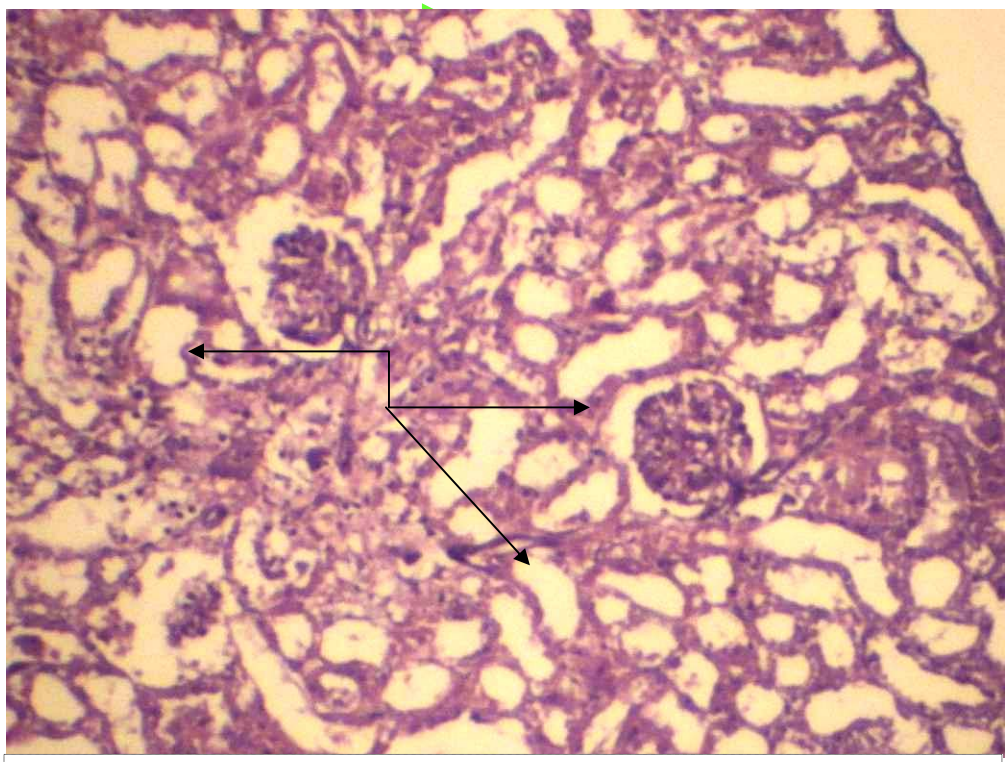

Fig (7): Kidney; moderate dilation of cortical tubules.

(H & E, 10x)

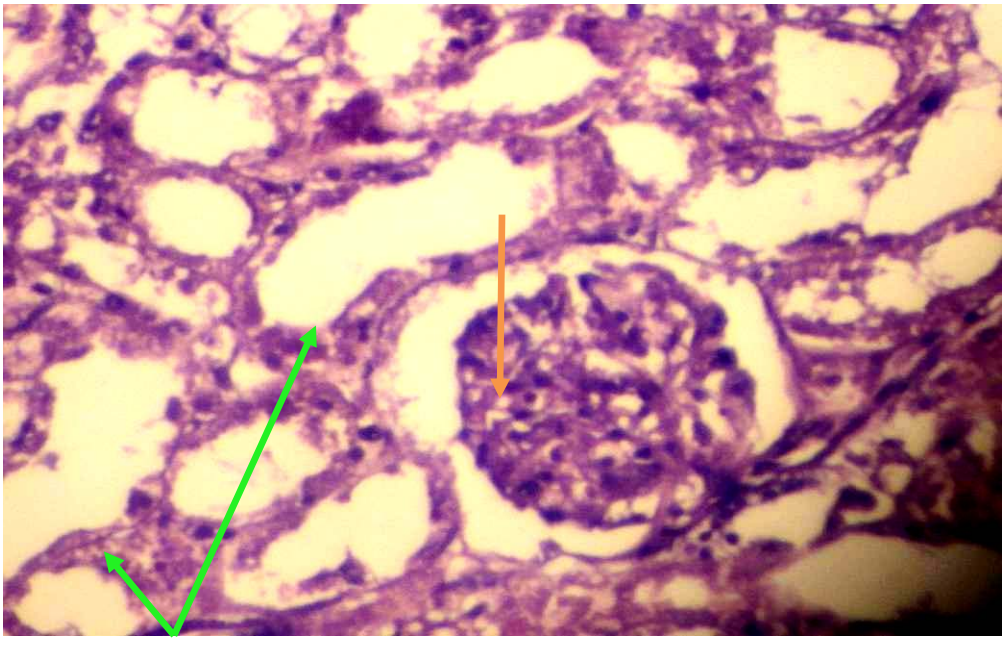

Fig (8): Kidney; note vacuolation of glomeruli and area of dilation of cortical tubules. (H & E, 40x)

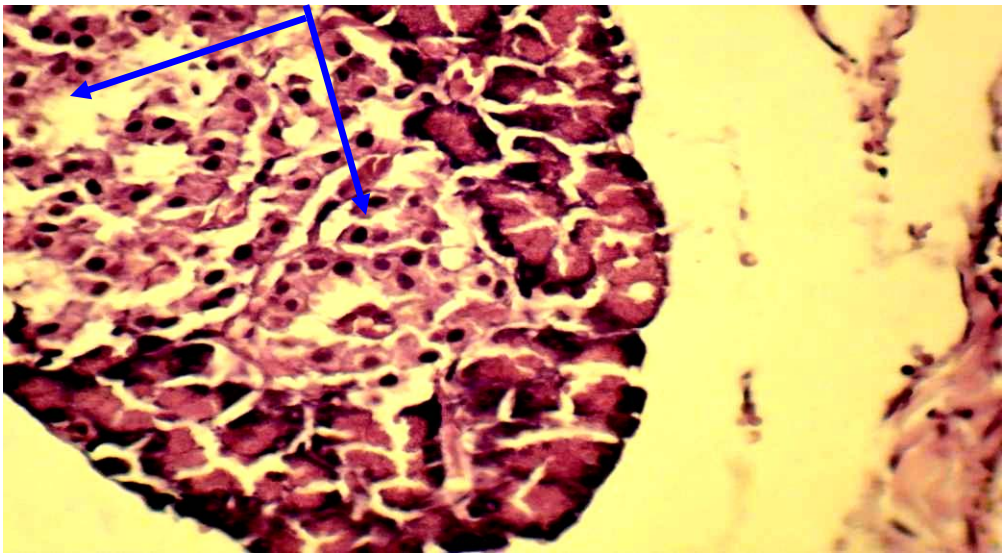

Fig (9): Pancreas; area of vacuolation and degeneration of islet of Langerhans.

(H & E,

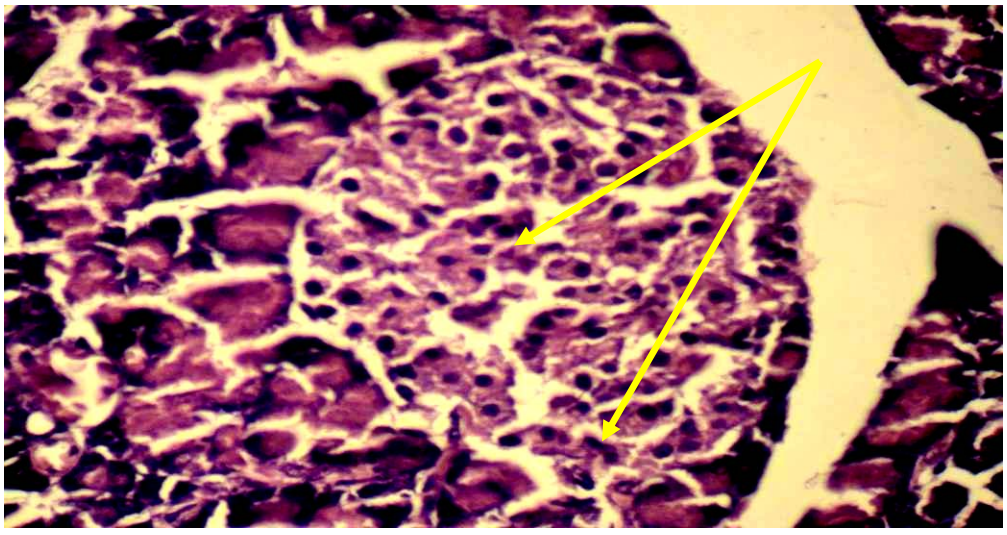

Fig (10): Pancreas; vacuolation and degeneration of islet of Langerhans.

(H

DISCUSSION

It might be imagined that in view of the vehemence with which sugar is condemned by some and the assurance with which benefits from reduction in sugar intake are often claimed or implied, there would be ample unequivocal supporting evidence on all these scores [1]. [18] urges 'It is highly desirable that every effort should be made to reduce sugar consumption drastically'. [19] 'recommends cutting down to a minimum the use of sucrose and other refined sugars to about 5% of the carbohydrate intake' (about 15 g sugar per day). 'This curtailment should be applied from birth'. According to [20] 'reduction in sugar consumption in the early stages of potential diabetes mellitus may give a possibility of a real prophylaxis against diabetes and perhaps also against other forms of illness of civilization. According to our experiment results; microscopic findings showed prominent changes in the liver such as degeneration and vacuolation of the hepatocytes and these agreed with [21] who reported that the histological examination of liver induced diabetic rats by sugar intake revealed marked degeneration with diffuse vacuolations of the hepatocytes. Additionally, the high concentration of honey caused irreversible changes in hepatocytes as in [22] who found that (40% honey) shows severe distortion of the radial arrangement of the sinusoids from the central vein. There is severe distortion of the hexagonal shape of the hepatocytes with evidence of hepatic necrosis characterized by karyolytic and karyorrhexic cells and the wall of the central vein of the liver is severely desquamated and there is evidence of irreversible cell death and these findings are in contrast with the findings of [23] who suggested that honey supplementation might give beneficial results in the prevention of hepatic damage induced by obstruction of the common bile duct. The duration of consumption of honey and the dose may play a key role in the outcome of the results. The damage to the liver by honey was dose dependent. Chronic use of honey may increase the risk of hepatic damage especially at higher doses. It is recommended that further studies be carried out on the effect of honey on the liver at lower doses. The fact that high sugar intake caused prominent changes in kidney such as varying degrees of dilatation of renal cortical tubules and vacuolation of glomeruli and this finding reinforce those of [24] who noticed that histopathological examination of kidney of sugar induced diabetic rats revealed degeneration of the glomeruli with wider Bowman’s spaces and diffuse vacuolation of the tissues. On other hand; several research as [25] revealed that the various degrees of degenerations observed in the liver

hepatocytes and kidney glomeruli of the diabetic rats confirmed the pathological complications of sugar-induced diabetes mellitus in the vital organs of the animal models. Furthermore, many pathological alterations in other visceral organs and tissues were varying degrees of degeneration and vacuolation of islet of Langerhans and these our findings agreed with [26,27&28] who mentioned that pancreas of substance-induced diabetic rats (sugar) revealed marked degeneration of the Islet of Langerhans, with severe vacoulations of the exocrine tissue. On the other hand, other researches mentioned that the highly intake of sugar caused necrosis of islets of pancreas as in [25&21] which reported that the normal appearance of the pancreas of food induced diabetic rat confirms the induction of Non-insulin Dependent Diabetes Mellitus (NIDDM) as a result of the insensitivity of receptors to insulin and the degeneration observed in the pancreas of sugar and alloxan-induced diabetic rats is due to the necrotic action on the β cells. This degeneration resulted in the inability of the pancreas to secrete adequate insulin for carbohydrate metabolism, which ultimately resulted in the onset of IDDM (Insulin Dependent Diabetes Mellitus). Finally, the present study reveals toxic effects of sugar on the liver, kidney and pancreas during the use of this substance in high dose. Therefore, more researches must be done on other organs of the body to highlight its effects on these organs.

CONCULOSIONS

The toxological pathology of sugar in laboratory white rats showed:

1. Treatment related changes in the liver mainly as varying degrees of vacuolation in the centrolobulare region and septal fibrosis.
2. Toxologic pathology lesions in the kidney as dilated cortical tubules and vacuolation of glomeruli.
3. Toxologic pathology changes in the islet of Langerhans of pancreas mainly as degeneration and vacuolation.

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