

Histological Features of Different Organs before and After Treatment of Diabetes By Using Avocado Extract in Rats

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ABSTRACT

Aim of the study: The present study aimed to study histological features of different organs before and after treatment of diabetes by using avocado extract in rats.

Materials and methods: Hot aqueous extraction of avocado was performed. Forty male rats (weighted 140–190g) were used in this study. Following the time of acclimatization, the animals had an overnight fast of 18 hours before being prepped for alloxan monohydrate-induced diabetes. Before and after induction, measurements of the animals' body weights and blood glucose levels were made. However, rats received an IP injection of alloxan 150 mg/kg bw. Following that, the rats' blood glucose levels were tracked every day for 3 weeks to establish a stable levels of blood glucose. The animals were divided into 4 groups: Group 1 got water as a non-induced (negative control) condition. Alloxan-induced rats in Group 2 received water as a positive control. Group 3: Alloxan-induced and aqueous extract-treated animals and Group 4 was only given a 40 g/L dose of the aqueous extract of avocado. Pancreas, livers, as well as kidneys from control, alloxanized, and treated rats were taken at different times, processed and utilized for histological examination after being preserved in 10% formaldehyde till processing and staining.

Results: The current results showed a significant difference between different groups especially in G3 at different weeks. However, rats in G2 exhibited depleted islet cells and regions of cell necrosis. The tiny, preserved islet cells (PIL) in diabetic rats treated with extract after 1 week (G3) were an improvement as compared with rats at G2. As the days advanced, more improvements were seen in the pancreatic architecture of the rats treated with extract, including the presence of more noticeable islet cells and exocrine cells. As seen by the intact pancreatic islet in G3, caused the healing of the pancreatic tissue after 3 weeks of treatment by extracts. Alloxanized rats (G2) showed the presence of cell necrosis as well as infiltrations of inflammatory cells. However, as the course of therapy continued, it became clear that the tissue architecture had improved, and more glomeruli were seen as well as fewer inflammatory cells (G3). Livers of rats in (G2) showed visible cell necrosis, when compared to the histology of G1 and G4. After receiving medication, rats in group G3 had compact, healthy liver tissues after three weeks.

In conclusion, the pancreas, kidneys, and liver were all protected by the avocado extract and showed enhancement in the histological architecture and glucose levels.

KEY WORDS: Diabetes, Avocado, Histology, Rats.

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INTRODUCTION

According to the many diabetes federations, the prevalence of diabetes mellitus has been increased [1]. The estimated worldwide increase of 37% is likely to be more than doubled in sub-Saharan Africa, where impaired glucose tolerance is forecast to grow by 75.8%, from 26.9 million in 2010 to 47.3 million in 2030 [2]. In sub-Saharan Africa, diabetes-related mortality was predicted to account for 6% of all deaths in 2010; this figure rose from 2.2-2.5% in 2000. The most economically productive age group, 20 to 39 years old, has the greatest absolute and relative death rates [2]. The incidence of diabetes has not been consistent in Nigeria, a country with over 250 tribes and diverse cultural and gastronomic traditions, yet rates vary from 1–7% of the population [3,4].

The incidence of diabetes has risen substantially during the last 30 years. 3.9% prevalence was reported for the Imo state by [5]. However, Nyenwe et al. in that same year reported a higher incidence rate in Port Harcourt (6.8%) [6]. According to estimates from 2004 in Nigeria, they believe that there are around 10 million diabetics in Nigeria, with almost half of them living in Lagos State due to its multicultural makeup [7]. These results show that diabetes has grown to be a significant public health concern.

Different techniques may be used by plants to affect blood sugar levels. Some plants may have substances similar to those found in insulin [8], inhibit the enzyme insulinase activity, increase the number of beta cells in the pancreas by triggering their regeneration [9, 10], or act as antioxidants by reducing the oxidative stress brought on by free radicals in the pancreas [11,12].

One of the 150 types of avocado pear is the *Persea americana* tree, which is a member of the Lauraceae family. This plant, also known as the avocado pear, is native to Central and South America, but it is also grown in the United States, Asia, certain regions of Europe, and Tropical Africa. The therapeutic value of this tropical plant's many components is immense. Authors [13] findings suggested that

using this plant's aqueous seed extract to treat hypertension might result in a favorable lipid profile. According to [14], who determined that the avocado extract anti-diabetic effects may be due to certain minerals as well as phytochemicals, and the ability to promote proper nutrient utilization might lead to an increase in weight. But according to [15] can only reduce blood sugar levels in moderate hyperglycemia. It cannot treat advanced hyperglycemia [15]. When authors examined the avocado aqueous extracts effects on diabetic and healthy rats made with alloxan, their findings revealed that the extract had a regenerating (protective) impact on pancreatic islet cells [16, 17].

The present study aimed to study histological features of different organs before and after treatment of diabetes by using avocado extract in rats.

MATERIALS AND METHODS

According to the N'guessan et al. [18], hot aqueous extraction technique was used for the investigation because extracts were traditionally made using hot water decoction.

Forty adult male rats (weighted 140–190 g) were used. The rats were kept in clean, airy cages with a constant temperature of about 28°C and a 12 hours light/dark cycle with free water and food.

Following the time of acclimatization, the animals had an overnight fast of 18 hours before being prepped for alloxan monohydrate-induced diabetes. Before and after induction, measurements of the animals' body weights and blood glucose levels were made. However, rats received an IP injection of alloxan 150 mg/kg. Following that, the rats' blood glucose levels were tracked every day for 3 weeks to establish a stable levels of blood glucose [18,19]. the animals were divided into 4 groups:

Group 1 got water as a non-induced (negative control) condition.

Alloxan-induced rat in Group 2 received water as a positive control.

Group 3: Alloxan-induced and aqueous extract-treated animals.

Group 4 was only given dose 40 g/L of the aqueous extract of *P. americana*.

Pancreas, livers, as well as kidneys from control, alloxanized, and treated rats were taken at different times and processed for histological examination after being preserved in 10% formaldehyde. An auto technique was used to treat the tissue, and the resultant slices, which were 5mm in thickness, were placed on the slides & stained with hematoxylin and eosin.

RESULTS

The current results showed a significant difference between different groups especially in G3 at different weeks (Table 1).

Table 1: Rats blood glucose levels in all experimental groups (Mean ± SE).

Groups	Zero day	1 week	2 weeks	3 weeks
G1	112±5.8 Ab	109.4±3.7 Ab	118.82±10.3 Ac	111.93±6.7 Ac
G2	449.1±17.87 Aa	437.15± 13.52Aa	442 ± 25.59Aa	454.6± 21.3 Aa
G3	441.33± 19.52Aa	372.8± 38 Bab	281.7± 26.1 Cb	184±42.6 Db
G4	116.91± 7.35Ab	112.03± 7.1Ab	109.55± 18.4Ac	116.18± 2.9Ac

Large letters denote differences between weeks ($p \leq 0.05$)
Small letters denote differences between groups ($p \leq 0.05$)

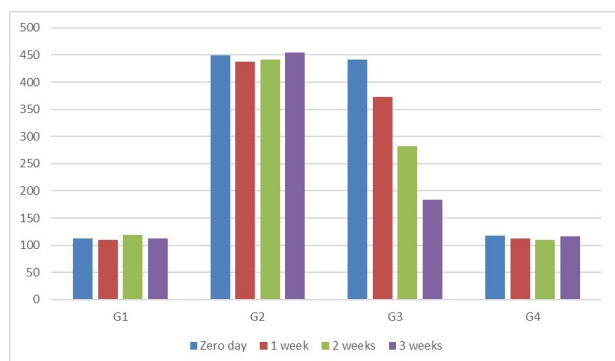


Fig. 1: Rats blood glucose levels in all experimental groups.

According to the histology of the pancreas in G1 and G4, the exocrine cells and pancreatic islets of the healthy control rats were unharmed (Fig. 2). However, rats in G2 exhibited depleted islet cells and regions of cell necrosis (Fig.3). The tiny, preserved islet cells (PIL) in diabetic rats treated with extract after 1 week (G3) were an improvement as compared with rats at G2. As the days advanced, more improvements were seen in the pancreatic architecture of the rats treated with extract, including the presence of more noticeable islet cells and exocrine cells (Fig. 4).

As seen by the intact pancreatic islet in G3, caused the healing of the pancreatic tissue after 3 weeks of treatment by extracts.

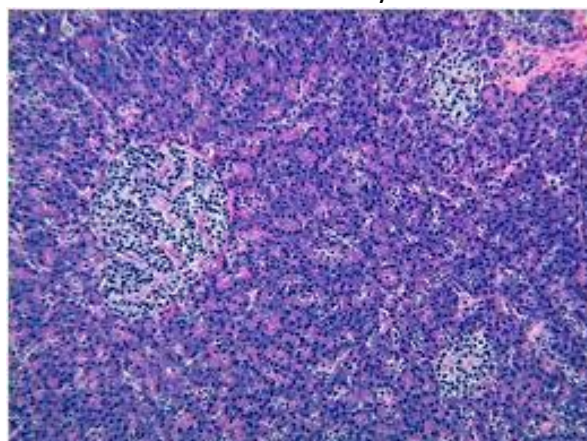


Fig. 2: Pancreas of G1 and G4 shows the exocrine cells and pancreatic islets of the healthy control rats unharmed (H&E) 400x.

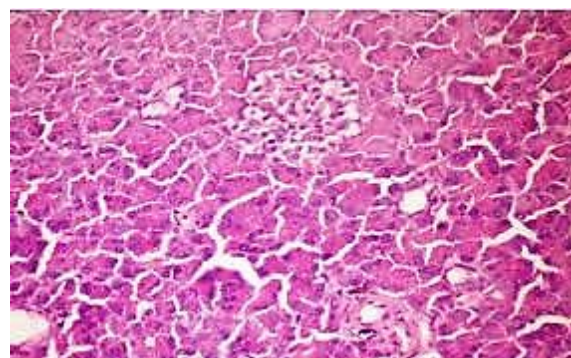


Fig. 3: Pancreas of G1 and G4 shows depleted islet cells and regions of cell necrosis (H&E) 400x

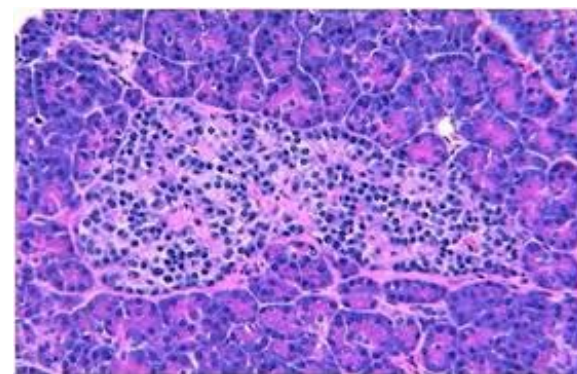


Fig. 4: Pancreas of G3 after 2 weeks shows presence of more noticeable islet cells and exocrine cells (H&E) 1000x

The kidney tissue of untreated (G1 and G4) showed normal architecture (Fig. 5), while alloxanized rats (G2) showed the presence of cell necrosis as well as infiltrations of inflammatory cells (Fig.6). However, as the course of therapy continued, it became clear that the tissue architecture had improved, and more glomeruli were seen as well as fewer inflammatory cells (G3) (Fig. 7).

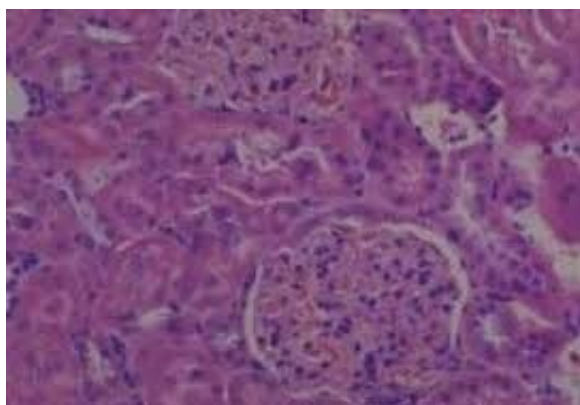


Fig. 5: Kidney of G1 and G4 shows histological architecture of kidney with unnoticeable pathological lesions(H&E) 400x

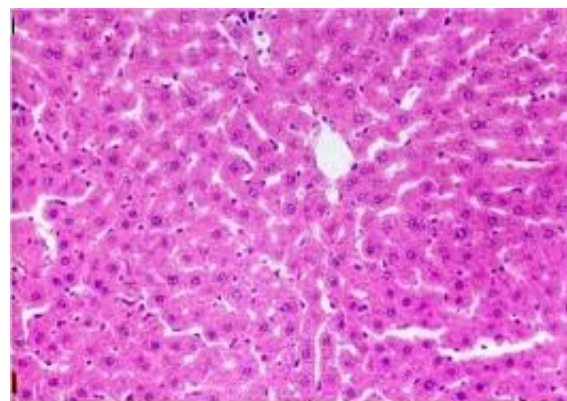


Fig. 9: Liver of G3 shows improvement of tissue architecture (H&E) 100x

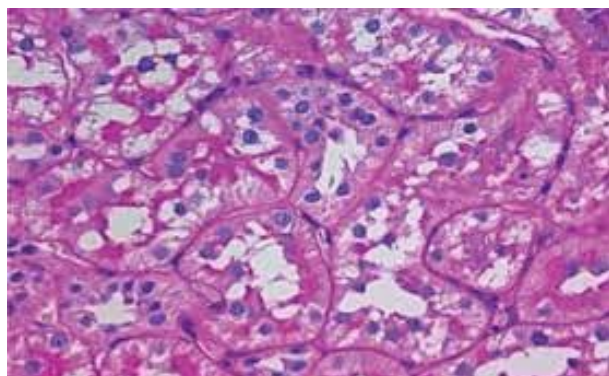


Fig. 6: Kidney of G2 shows cell necrosis as well as massive infiltrations of inflammatory cells (H&E) 1000x

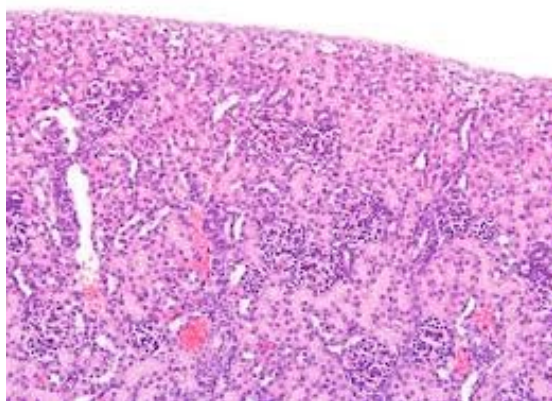


Fig. 7: Kidney of G3 shows improvement in tissue architecture with infiltrations of few inflammatory cells (H&E) 100x

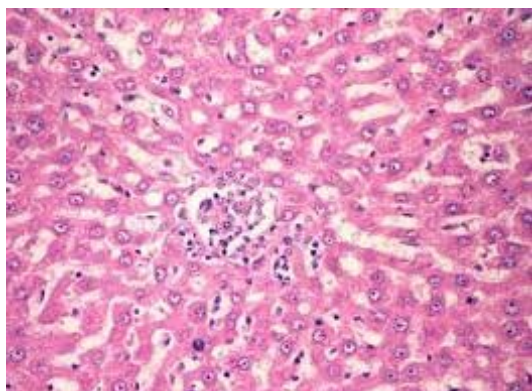


Fig. 8: Liver of G2 shows focal necrosis (H&E) 400x

DISCUSSION

Blood glucose levels significantly decreased ($P < 0.05$) in the current investigation when aqueous extracts were used. This data would suggest that the extract contains hypoglycemic substances. According to the findings, extracts have hypoglycemic and antihyperglycemic properties, which is in line with the findings of other studies [14,18,20].

These phytochemicals have been shown to have therapeutic benefits. Flavonoids, which are well-known to be potent antioxidants and may help protect organs against toxicity or oxidative stress caused by substances like alloxan, have been shown to be an active component in many herbal medications [21,22]. The plant extract's apparent hypoglycaemic activity may have been influenced by saponins, which have been found to exhibit hypoglycaemic activity [23]. This activity may be caused by the suppression of liver glycogenesis or glycolysis. Additionally, according to [24], flavonoids, tannins, and saponins have hypoglycemic effects through inhibiting sodium-glucose transporter 1. (S-GLUT1).

Degeneration of pancreatic islet cells was seen in histopathological analyses of diabetic control rats, which was consistent with prior findings [18,19]. Insulin insufficiency most likely resulted from this trait. Hyperglycemia is a result of high elevation and inadequate utilization of blood glucose, which is caused by insulin insufficiency (or diabetes mellitus). The diabetic rats who received the extracts showed increased islets volume density as well as higher proportion of beta cells, which may be an indication of regeneration, according to

this histological investigation of diabetes-treated groups. Regeneration of beta cells, stimulation of insulin secretion from surviving beta cells in the islets of Langerhans, and lowered blood sugar levels are all effects seen after taking certain plant extracts (9,10). Since higher doses of the extract were more effective at restoring islet cells in diabetic rats, scientists hypothesize that contains chemical components that either have regenerative effects on beta-cells, stimulate these cells to produce more insulin (pancreatotropic action), or have some insulin-like substances. The capacity of to repair and reverse the previously injured tissues of alloxan-induced rats allows one to examine the plant's tissue-protective impact, and the result is consistent with other researchers' findings. According to research by [11], the antioxidant impact of *Catharanthus roseus* Linn (Apocynaceae) on the pancreas, which avoided damage from oxygen-free radicals, was the cause of the plant's anti-diabetic function. According to [25], the stem bark of *Terminalia arjuna* restored pathological damages that were generated in the cells of rats with diabetes produced by alloxan.

By examining the effects of the combination extracts of *Vernonia amygdalina* and *Azadirachta indica* on pancreas as well as livers histology of normal and diabetic rats, [26] examined the antidiabetic mechanism. In streptozotocin-induced diabetic rats, this group claimed that liver and pancreatic damage had been repaired or reversed. In another study, Teoh et al. found that the bitter melon *Momordica charantia*, which is known for its anti-diabetic effects, helped protect the kidneys of diabetic rats that had been given streptozotocin [27].

CONCLUSION

The pancreas, kidneys, and liver were all protected by the avocado extract and showed enhancement in the histological architecture and glucose levels.

Conflicts of Interests: None

Author Contributions

Ali A. Tala'a: Writing of the article

Rafid Khalid Ali: Practical work

Lubna Dhari Mohammed: slides and histological readings

Reyam Abdul Khuder Mohammed: statistical analysis

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