



ETHANOLIC EXTRACT OF GINGER ON THE HISTOLOGY OF THE PANCREAS IN ADULT WISTAR RATS

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ABSTRACT

Zingiber officinale (ginger) is an underground stem or rhizome which is known to have originated from Asia and have been reported to have a number of medicinal properties which is used in the treatment of many ailments such as arthritis, painful menstrual periods, nausea etc. It is also used as a common specie in food and bakery industries. Due to the availability and medicinal uses of ginger, the effect of the ethanolic extract on the histology of the pancreas of adult wistar rats was investigated. Twenty five (25) adult Wistar rats weighing 125–200g were divided into five groups (A, B, C, D and E) each with five rats. The animals in group A and B served as control groups and received distilled water and olive oil respectively, the animals in groups C, D and E served as experimental groups, and received 100mg/kg, 250mg/kg and 500mg/kg body weight of the ethanolic extract of Zingiber officinale respectively. The animals received the extract for 14 days and were sacrificed 24 hours after the last administration and routinely processed histologically. The study shows that there is disintegration of the islet cells of Langerhans (IL) with pyknotic nuclei, but no visible change or alteration in the serous acini (SA) of the pancreas. It is observed that extract of ginger has adverse effect on the integrity of the islet cells of Langerhans.

Keywords: Ginger, Histology, Ethanolic extract, Pancreas, Wistar rat, Treatment, Plant.

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1. INTRODUCTION

Plants are the basic source of knowledge of modern medicine. The burgeoning worldwide interest in medicinal plants reflects recognition of the validity of many traditional claims regarding the value of natural products in health care [1]. Several plants of diverse origins have been exploited by trial and error over many generations for therapeutic purposes. In Africa and in most of the developing countries, plants' properties are empirically appreciated.

The adverse effects of chemical drugs, their increasing costs and greater public access to information on traditional medicine have also led to an increase in interest in alternative

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treatments. The reason is that traditional medicine is a medicine of proximity, less constraining and non-expensive [2]. The importance of herbs in the management of human ailments cannot be overemphasized. It is clear that the plant kingdom harbours an inexhaustible source of active ingredients invaluable in the management of many intractable diseases [3]. Traditional medicines are used by about 60% of the world population in both developing and developed countries where modern medicines are predominantly used while an estimated 60-80% Africa's population depends solely on herbal remedies for its primary health care needs [4]. Despite remarkable progress in the management of various diseases including diabetes mellitus by synthetic drugs, there has been a renewed interest in indigenous antidiabetic agents especially medicinal plants, herbs and spices as reviewed by Tapsell, *et al.* [5]. Among these, most noted are ginger and garlic which appear most effective and least toxic [6]. Phytochemical studies have shown that the unique culinary and medicinal properties of ginger are due to the presence of phytochemicals like zingerone, shogaols, gingerols, paradols, β -phellandrene, curcumene, cineole, geranyl acetate, terphineol, terpenes, borneol, geraniol, limonene, β -elemene, zingiberol, linalool, α -zingiberene, β -sesquiphellandrene, β -bisabolene, zingiberenol and α -farnesene [7, 8]. Scientific studies carried out in accordance to the principles of modern system of medicine have convincingly shown that ginger possesses numerous health benefits like antimicrobial, antiviral, gastroprotective, antidiabetic, anti-hypertensive, cardioprotective, anticancer, chemopreventive and immunomodulatory effects [7, 9].

The pancreas is a glandular organ in the digestive system and endocrine system of vertebrates. In humans, it is located in the abdominal cavity behind the stomach. It is an endocrine gland producing several important hormones, including insulin, glucagon, somatostatin, and pancreatic polypeptide which circulate in the blood. The pancreas is also a digestive organ, secreting pancreatic juice containing digestive enzymes that assist digestion and absorption of nutrients in the small intestine. These enzymes help to further break down the carbohydrates, proteins, and lipids in the chyme. Anatomically, the pancreas is divided into a *head*, which rests within the concavity of the duodenum, a *body* lying behind the base of the stomach, and a *tail*, which ends abutting the spleen. The *neck* of the pancreas lies between the body and head, and is in front of the superior mesenteric artery and vein. The head of the pancreas surrounds these two vessels, and a small *uncinate process* emerges from the lower part of the head, lying behind the superior mesenteric artery. [10] The pancreas is part of the digestive system and plays an important role in the digestion of food and absorption of nutrients. Pancreatic cancer will usually result in dietary-related symptoms, which can include appetite changes, weight loss and changes in bowel habits. Some people may also develop diabetes and you will be monitored for this as part of your care.

The aim and objective of the present study is to examine the effects of ginger extract on the histology of the pancreas using adult Wistar rats.

2. MATERIALS AND METHOD

2.1. Preparation of Ethanolic Extract of *Zingiber Officinale* Plant

A fresh ginger root was purchased from the Marian market in Calabar Muncipal Council, Cross River State, Nigeria. The roots were identified and authenticated by the botanist in the botany department, university of Calabar, Calabar.

2.5kg of fresh ginger rhizome was cleaned, washed under running tap water, cut into small pieces, air dried for two weeks and crushed into powdered form using an electric blender

2000g (2kg) of this powdered ginger was macerated completely in 5000ml of 99.9% ethanol and shaken vigorously. It was allowed to stand for 48 hours at room temperature and was stirred at intervals.

After 48 hours, the dissolved ginger in ethanol was filtered using at first a material with small pores after which it was filtered again using No1 whatmann paper (filter paper) and funnel. The filtrate was collected in a tray and was air dried for 5 days. This was to ensure the complete evaporation of the ethanol used.

The ginger paste obtained was collected from the tray with the aid of a spatula into a container and was measured using an electric weighing balance. 50g of ginger paste was extracted and was then dissolved in 100ml of extra virgin olive oil (which served as the vehicle). This extract was kept in a dry place at room temperature.

2.2. Breeding/Grouping of Animals

Twenty-five adult albino male wistar rats weighing between 125-200g were purchased from the department of pharmacology animal farm, university of Calabar, Calabar. These animals were housed in well ventilated animal cages and were kept in the animal house of the department of Human Anatomy, Faculty of Basic Medical Sciences, College of Medical Sciences, University of Calabar. The animal house was properly fitted with bright light and environmental temperature always kept at a range of 28°C to 32°C. The house was constantly kept clean and disinfected.

The animals were fed with growers mesh obtained from vital feed located in Calabar and Distilled water daily with the aid of water bottles and were allowed to acclimatize for a period of 14 days.

After the fourteenth day of acclimatization, the rats weighed between 125-200g, but the weight significantly changed after administration of extract in the treated animals. They were then randomly selected into five groups with each group containing five rats in well labelled cages.

2.3. Plant Extract Administration

The animals were divided into five groups with five rats each.

GROUP A: These animals were given distilled water and served as the control.

GROUP B: These animals served as the vehicle control and received olive oil.

GROUP C: was the low dose group. They were administered 100mg/kg body weight of the ethanolic extract of *Zingiber officinale*.

GROUP D: was the medium dose group. The animals were administered 250mg/kg body weight of the ethanolic extract of *Zingiber officinale*.

GROUP E: was the high dose group. The animals were administered 500mg/kg body weight of the ethanolic extract of *Zingiber officinale*.

Each animal in the experimental groups was administered the plant extract based on its body weight and administration was done using the oral route throughout the period of the experiment (which lasted for 14 days) after which the animals were sacrificed, pancreas harvested and processed for histological observation.

3. STATISTICAL ANALYSIS

Statistical analysis was performed using analysis of variance and student's t-test. Experimental data was presented as mean \pm standard error of mean (SEM). Values of $p < 0.05$ were taken to be statistically significant.

4. RESULT

Normal control (Group A): This group received no extract of *Zingiber officinale* but was given feed and distilled water. Section of the pancreas showed both exocrine and endocrine part. The exocrine part is made up of numerous serous acini lined by cuboidal epithelium and the islet cells of Langerhans (IL) consists of cluster of oval cells with blood capillaries. The cells have deeply basophilic nuclei with eosinophilic cytoplasm (Plate 1).

Vehicle control (Group B): This group received no extract of ginger but was given feed, olive oil and distilled water. Section of the pancreas shows normal histological features, prominent serous acini which are highly basophilic (bluish staining) with cuboidal epithelium and the lumen are seldom seen. At some places the acini are separated by areas where the aggregation of cells are quite different from those of the acini, these aggregation forms the pancreatic islets or islet cells of Langerhans (IL) which are endocrine in function. (Plate 2)

Group C (Low dose): This group received low dose of 100g/kg body weight of the ethanolic extract of ginger for a period of 14 days. The section shows lost nuclei material and disintegration of the islet cell (IL). It shows numerous serous acini with normal histological features, and blood capillaries. The cell also has basophilic nuclei with eosinophilic cytoplasm. (Plate 3)

Group D (Medium dose): This group received medium dose of 250g/kg of the body weight of the ethanolic extract of ginger for a period of 14 days. Section of the pancreas shows disintegration of the islet cells of Langerhans in the endocrine part of the pancreas. Both the exocrine parts show normal histological features with prominent serous acini (SA) lined by cuboidal epithelium, the cells have deeply basophilic nuclei with eosinophilic cytoplasm. (Plate 4)

Group E (High dose): This group received high dose of 500g/kg of the body weight of the ethanolic extract of ginger for 14 days. Section of the pancreas shows both exocrine parts shows numerous serous acini (SA) lined by cuboidal epithelium. It shows disintegration of the islet cell of Langerhans (IL) with pyknotic nuclei, no visible change in the serous acini (SA). (Plate 5).

5. DISCUSSION

Zingiber officinale commonly known as 'ginger' has its origin traced to Asia. It has a lot of medicinal uses as far as herbal medicine is concerned. It has been proven to have anticovulsant, antidiuretic, anti-inflammatory, diuretic, antifungal, antihypertensive, antispasmodic, antitumor, and anticancer. It has other medicinal values which are too

Ginger is widely used in different parts of the world as a spice for cooking different kinds of food and also in the baking industries as flavour and spice for making biscuits, bread and cakes. It can be eaten raw and as food additive. Certain people also used zingiber officinale in ginger ale, ginger breads, ginger snaps, ginger cake and ginger biscuits [11]. Ginger contains volatile oils (~1% to 3%) and non-volatile pungent components oleoresin Zick, et al. [12]. A variety of active components were identified in the oleoresin of ginger including gingerols and shogaols.

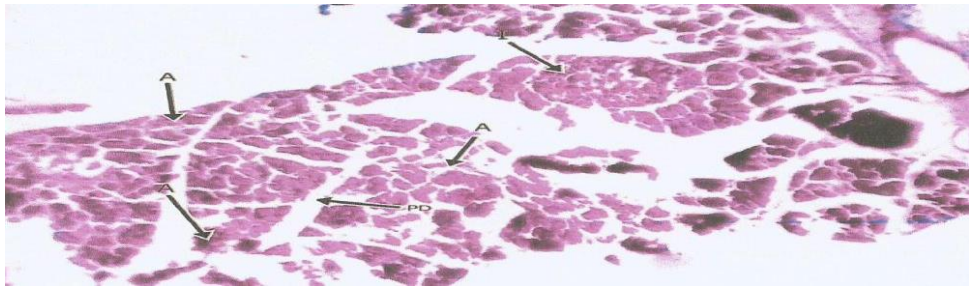
Gingerols are a series of homologues with varied un branched alkyl chain length, whereas shogaols are a series of homologues derived from gingerols with dehydration at the C-5 and C-4 during long-term storage or thermal processing. Other active compounds from the oleoresin portion of ginger were also reported, such as 6-paradol; 6- and 10-dehydrogingerdione; 6-and 10-gingerdione; 4, 6, 8, and 10-gingerdiol; 6- methylgingerdiol; zingerone; 6-hydroxyshogaol; 6-, 8-, and 10-dehydroshogaol; and diarylheptanoids Sang, et al. [13]. Among these compounds, gingerols and shogaols are the major constituents of oleoresin, while the other compounds are present in a limited amount, accounting for 1-10% of the overall amount of gingerols and shogaols Sang, et al. [13]. Gingerols (especially 6-gingerol) are the major components in the fresh ginger rhizome. The amount of shogaols is increased in the dried ginger, as evidenced by the reduction of the ratio of 6-gingerol to 6-shogaol from 10:1 in fresh ginger to 1:1 in dried ginger Wu, et al. [14]. Since ginger extracts contain various components, it would be important to identify which compounds are responsible for their pharmacological effects. It was demonstrated that 6-, 8-, and 10-gingerols and 6-shogaol showed efficacy in anti-inflammatory, antibacterial, antipyretic, antilipidemic, antitumorogenic, and antiangiogenic effects Park, et al. [15]. In addition, 6- gingerol was shown to inhibit leukotriene A4 hydrolase (LTA4H) and suppress anchorage-independent cancer cell growth in colorectal cancer cells (HCT116 and HT29) with IC₅₀'s of 50 and 35 uM, respectively [16]. Sang, et al. [13] demonstrated that 6-, 8-, and 10- shogaols exhibited much higher antiproliferative potency than 6-, 8-, and 10-gingerols against human lung cancer cells (H-1299) with IC₅₀'s of 8µM for 6-shogaol and 150 µM for 6-gingerol. In addition, 10-gingerol was the most potent among the gingerol Sang, et al. [13] Furthermore, Dugasni, et al. [17] found that 6-shogaol showed the most potent efficacy of antioxidative activity with an IC₅₀ of about 8µM, while 6, 8, and 10-gingerols had IC₅₀'s of 28, 20, and 12µM, respectively.

This study aimed to elucidate the effect of ethanolic extract of ginger on the histology of the pancreas, using Wistar rats. Twenty five Wistar rats weighing 125-200g were used and divided into five groups, each group with five rats (A, B, C, D and E). Group and B were used as control and vehicle control respectively, while C, D and E served as experimental groups. The observed effect is largely due to the presence of 6-8-10 gingerols and 6-10-shogaols which are the affective

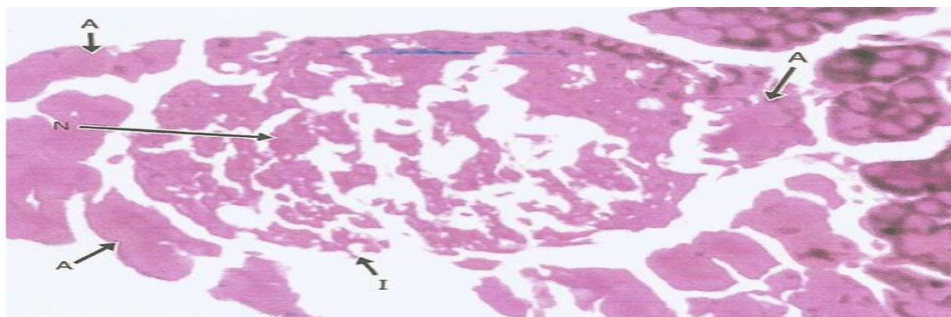
components responsible for its pharmacology effect. Park, et al. [15]. The study shows that there is disintegration of the islet cells of Langerhans (IL) with pyknotic nuclei but no visible change of alteration in the serous acini (SA) of the pancreas.

6. CONCLUSION

From the above result, it can be concluded that extract of ginger may have adverse effect on the integrity of islet cells of Langerhans.

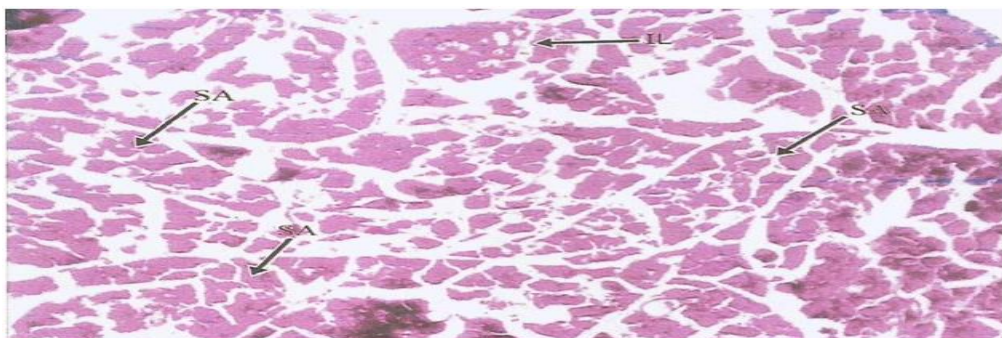


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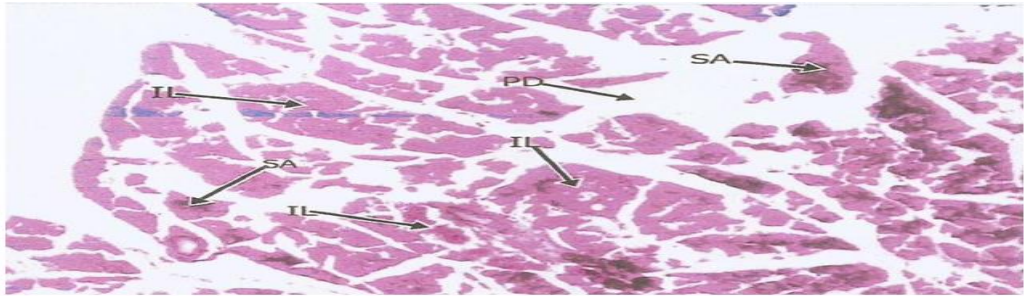


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Plate-1. Photomicrograph of the control pancreas showing exocrine part made up of numerous serous acini lined by cuboidal epithelium and the islet of Langerhans (IL) consist of cluster of oval to cells with blood capillaries. The cells have deeply basophilic nuclei with eosinophilic cytoplasm.

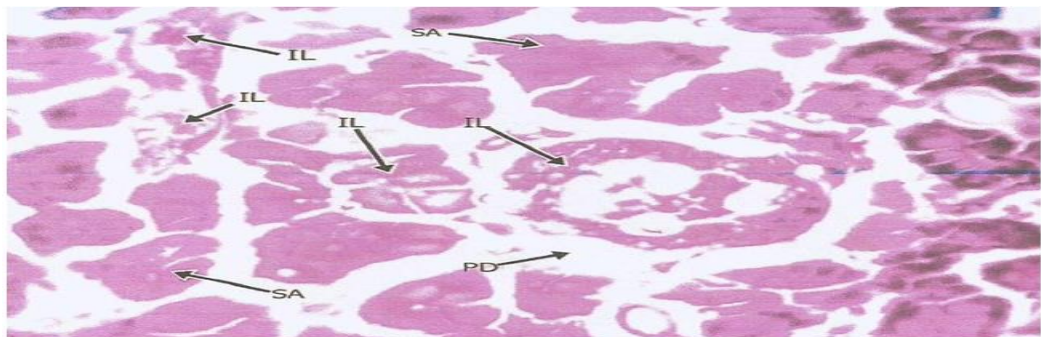


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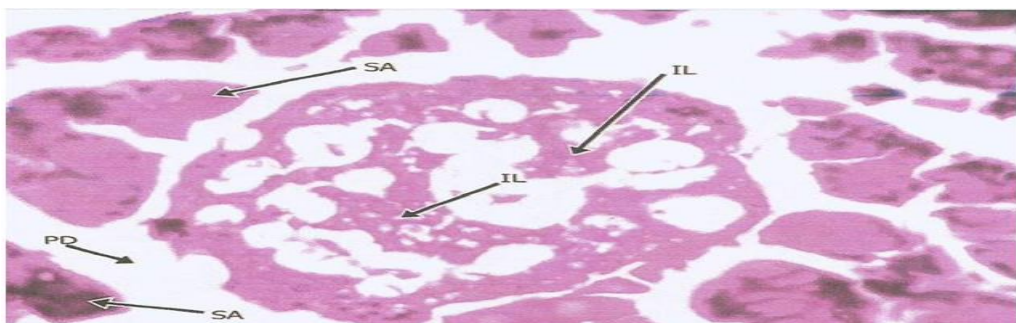


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Plate-2. Photomicrograph of vehicle control fed with olive oil shows normal histological features, prominent serous acini which are high basophilic (bluish staining) with cuboidal epithelium and the lumen are seldom seen. At some places the acini are separated by areas where the aggregation of cells are quite different from those of the acini, these aggregation form the pancreatic islets or islet cells of Langerhans (IL) which are endocrine in function

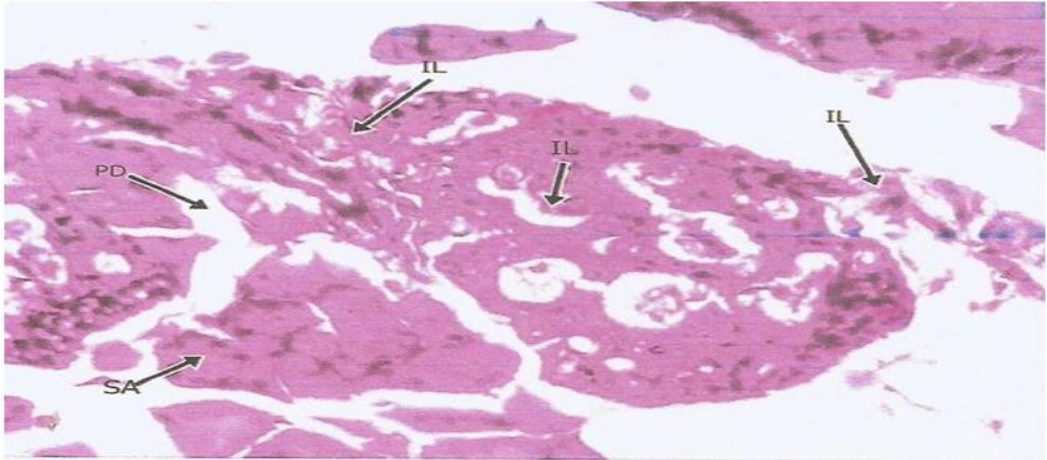


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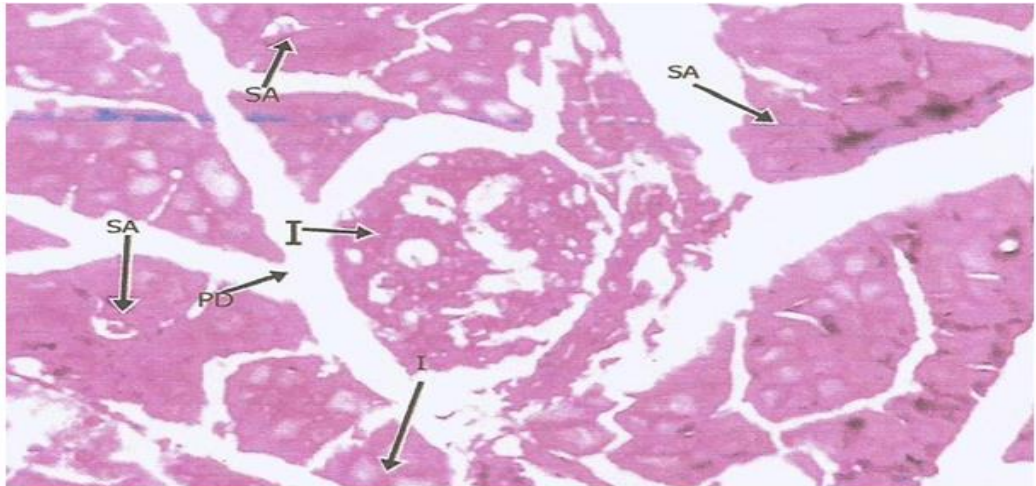


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Plate-3. Photomicrograph of the low dose pancreas showing lost nuclei material and disintegration of the islet of Langerhans cell (IL). It shows numerous serous acini with normal histological features and blood capillaries. The cell also has basophilic nuclei with eosinophilic cytoplasm.

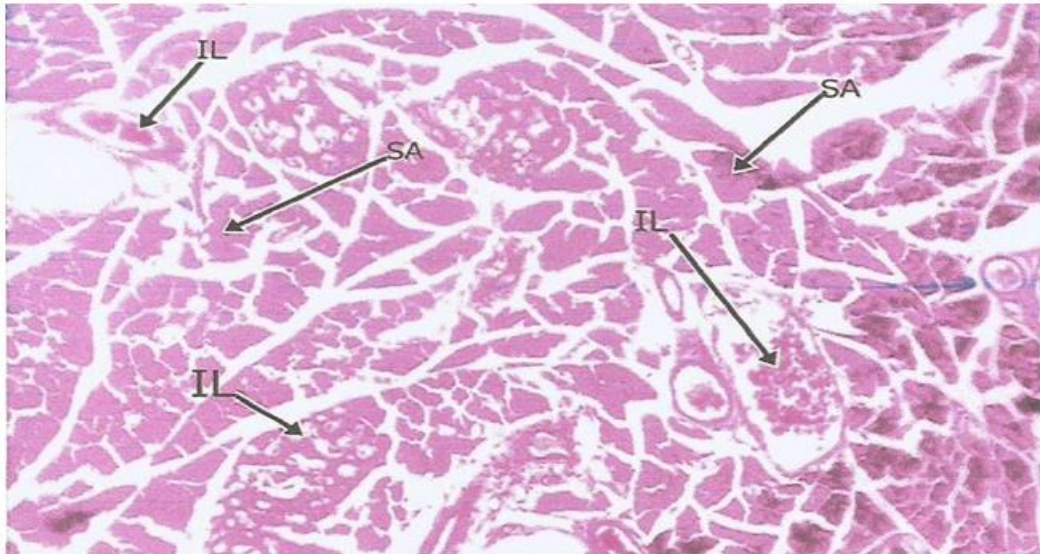


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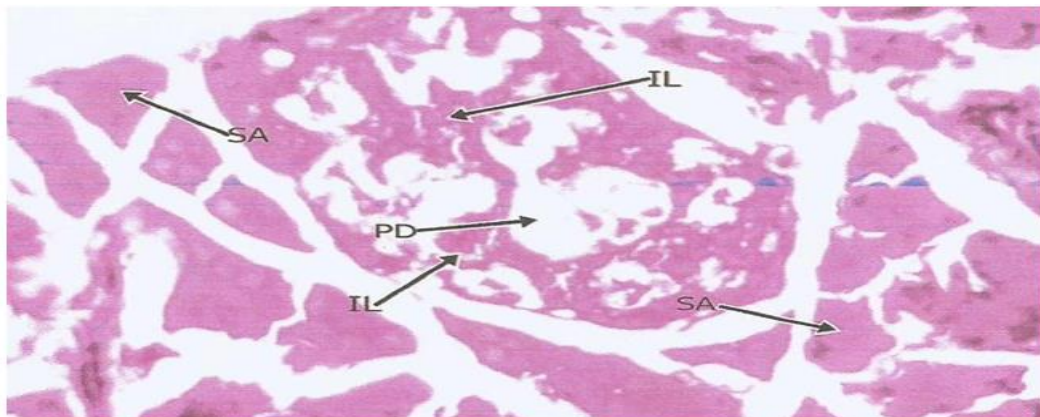


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Plate-4. Photomicrograph of medium dose pancreas showing lost nuclei material and disintegration of the islet cell (IL). It shows numerous serous acini with normal histological features and blood capillaries. The cell also has basophilic nuclei with eosinophilic cytoplasm.



Mag x100



Mag x100

Plate-5. Photomicrograph of High dose pancreas showing both exocrine and endocrine part. The exocrine part shows numerous serous acini (SA) lined cuboidal epithelium. It shows disintegration of the islet cell of Langerhans (IL) with pyknotic nuclei, no visible change in the serous acini (SA).

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REFERENCES

- [1] M. Ahmed and F. Hussain, "Chemical composition and biochemical activity of aloe vera (*Aloe Barbadensis* Miller) leaves," *International Journal of Chemical and Biochemical Sciences*, vol. 3, pp. 29-33, 2013.

- [2] O. S. Agunbiade, O. M. Ojezele, J. O. Ojezele, and A. Y. Ajayi, "Hypoglycaemic activity of commelina Africana and ageratum conyzoides in relation to their mineral composition," *African Health Sciences*, vol. 12, pp. 198–203, 2012.
- [3] M. B. Palaksha and K. Ravishankar, "Phytochemical screening and evaluation of in vitro antibacterial and antihelminthic activities of sida acuta leaf extracts," *Journal of Chemical and Pharmaceutical Research*, vol. 4, pp. 4757–4761, 2012.
- [4] A. O. Adesuyi, O. A. Awosanya, F. B. Adaramola, and A. I. Omeonu, "Nutritional and phytochemical screening of aloe barbadensis," *Current Research Journal of Biological Sciences*, vol. 4, pp. 4 – 9, 2011.
- [5] L. C. Tapsell, I. Hemphill, L. Cobiac, C. S. Patch, D. R. Sullivan, M. Fenech, S. Roodenrys, J. B. Keogh, P. M. Clifton, P. G. Williams, V. A. Fazio, and K. E. Inge, "Health benefits of herbs and spices: The past, the present, and the future," *Med. J. Aust.*, vol. 185, pp. S4-S24, 2006.
- [6] K. Srinivasan, "Plant foods in the management of diabetes mellitus: Spices as beneficial antidiabetic food adjuncts," *Int. J. Food Sci. Nutr.*, vol. 56, pp. 399-414, 2005.
- [7] M. Baliga, R. Haniadka, M. Pereira, J. D'Souza, and P. Pallaty, "Update on the chemopreventive effects of ginger and its phytochemicals," *Crit Rev Food Sci Nutr.*, vol. 51, pp. 499-523, 2011.
- [8] R. Haniadka, E. Saldanha, V. Sunita, P. Palatty, and R. Fayad, "A review of the gastroprotective effects of ginger (Zingiber Officinale Roscoe)," *Food Funct.*, vol. 4, pp. 845-855, 2013.
- [9] B. Ali, G. Blunden, M. Tanira, and A. Nemmar, "Some phytochemical, pharmacological and toxicological properties of ginger (Zingiber Officinale Roscoe): A review of recent research," *Food Chem Toxicol.*, vol. 46, pp. 409-420, 2008.
- [10] R. L. Drake, W. Vogl, M. W. M. Tibbitts Adam, Richard, and P. Richardson, *Gray's anatomy for students*. Philadelphia: Elsevier/Churchill Livingston. ISBN 978-0-8089-2306-0, 2005.
- [11] K. Hashimoto, K. Satoh, P. Murata, B. Makino, I. Sakakibara, Y. Kase, A. Ishige, M. Higuchi, and H. Sasaki, "Component of zingiber officinale that improves the enhancement of small intestine transport," *Plant Med.*, vol. 68, pp. 936-939, 2002.
- [12] S. Zick, Z. Djuric, M. Ruffin, A. Litzinger, D. Normolle, and S. Alrawi, "Pharmacokinetics of 6-gingerol, 8-gingerol, 10-gingerol and 6-shogaol and conjugate metabolites in healthy human subjects," *Cancer Epidemiol Biomarkers Prev.*, vol. 17, pp. 1930-1936, 2008.
- [13] S. Sang, J. Hong, H. Wu, J. Liu, C. Yang, and M. Pan, "Increased growth inhibitory effects on human cancer cells and anti-inflammatory potency of shogaols from zingiber officinale relative to gingerols," *J Agric Food Chem.*, vol. 57, pp. 207-215, 2009.
- [14] H. Wu, M. Hsieh, C. Lo, C. Liu, S. Sang, and C. Ho, "6-Shogaol is more effective than 6-gingerol and curcumin in inhibiting 12-O-tetradecanoylphorbol 13- acetate-induced tumor promotion in mice," *Mol Nutr Food Res.*, vol. 54, pp. 1296-1306, 2010.

- [15] M. Park, J. Bae, and D. Lee, "Antibacterial activity of [10]-gingerol and [12]-gingerol isolated from ginger rhizome against periodontal bacteria," *Phytother Res.*, vol. 22, pp. 1446-9, 2008.
- [16] C. Jeong, A. Bode, A. Pugliese, Y. Cho, H. Kim, J. Shim, Y. Jeon, H. Li, H. Jiang, and Z. Dong, "[6]-Gingerol suppresses colon cancer growth by targeting leukotriene A4 hydrolase," *Cancer Res. Pub. Med.*, vol. 69, pp. 5584-5591, 2009.
- [17] S. Dugasni, M. Pichika, V. Nadarajah, M. Balijepalli, S. Tandra, and J. Korlakunta, "Comparative antioxidant and anti-inflammatory effects of [6]-gingerol, [8]-gingerol, [10]-gingerol and [6]-shogaol," *Journal of Ethnopharmacol*, vol. 127, pp. 515-20, 2010.

BIBLIOGRAPHY

- [1] K. Hashimoto, K. Satoh, P. Murata, B. Makino, I. Sakakibara, Y. Kase, A. Ishige, M. Higuchi, and H. Sasaki, "Component of zingiber officinale that improves the enhancement of small intestine transport," *Plant Med.*, vol. 68, pp. 936-939, 2002.

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