eISSN: 09748369, www.biolmedonline.com

Effects of honey on the histology of liver in adult Wistar rats

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Abstract
Honey, containing mainly fructose and glucose, is either taken as curative agent or substitute for refined sugar, yet its chronic effect on liver morphology has not been reported. This study reports an investigation into the histological changes in adult Wistar rats exposed to chronic consumption of honey. Twenty adult Wistar rats (170 - 200 grams) were divided into four groups of five rats each. The rats were fed daily with 0%, 20%, 30%, and 40% of honey mixed with 100, 80, 70 and 60 grams of animal chow in groups I, II, III and IV respectively for eight weeks. Histological analysis of the liver showed distortion of the radial arrangement of the sinusoids, hepatic necrosis and desquamated wall of the central vein in the treated groups, while the control rats appeared normal. The damage noticed was dose-dependent. Chronic consumption of honey may increase the risk of hepatic damage.

Keywords: Erythrocytes; Honey; Karyolytic cells; Liver; Sialidase.

Introduction

Honey is a sweet and viscous fluid produced by honeybees (and some other species), and derived from the nectar of flowers. It has a similar composition of granulated sugar (50% fructose and 44% glucose) and approximately the same relative sweetness, 97% of the sweetness of sucrose (Riddle, 2001; National Honey Board, 2008). Honey is a mixture of sugars and other compounds. With respect to carbohydrates, honey is mainly fructose (about 38.5%) and glucose (about 31.0%), making it similar to the synthetically produced inverted sugar syrup which is approximately 48% fructose, 47% glucose, and 5% sucrose. Honey's remaining carbohydrates include maltose, sucrose, and other complex carbohydrates (Riddle, 2001).

Honey contains trace amount of several vitamins and minerals (Standifer, 2007). As with all nutritive sweeteners, honey is mostly sugars and is not a significant source of vitamins or minerals. The specific composition of any batch of honey will depend largely on the mix of flowers available to the bees that produced the honey. Typical honey analysis shows the following: Fructose: 38.0%, Glucose: 31.0%, Sucrose: 1.0%, Water: 17.0%, other sugars (maltose, melezitose): 9.0%, Ash: 0.17%, Others: 3.38% (Erguder et al., 2008). Honey also contains tiny amounts of several compounds thought to function as antioxidants, including chrysin, pinobanksin, vitamin C, catalase, and pinocembrin (Martos et al., 2000).

Honey provides antibacterial, anti-inflammatory, immune-stimulant, antiulcer and wound/burn healing (regenerative) effects (Fiorani et al., 2006). Free radicals lead to oxidative damage in many molecules, such as lipids, proteins and nucleic acids. Many complications have been attributed to oxidative damage, including atherosclerosis, aging, and cancerous diseases. Antioxidant foods that are rich in flavonoids are protective agents against these ailments (Perez et al., 2006). Antioxidants in honey have also been implicated in reducing the damage done to the colon in colitis (Bilsel et al., 2002). Honey intoxication is more likely when using "natural" unprocessed honey and honey from farmers who may have a small number of hives. Commercial processing, with pooling of honey from numerous sources generally dilutes any toxins (Walderhaug, 2001).

Al-Waili et al. (2006) in assessing the effects of various diets, including total food restriction with 50% honey feeding, total food restriction with 50% dextrose feeding or *ad libitum* (control group) commercial regular diet, on the haematology and biochemical variables, and to assess the effects of the various diets on the influence of acute blood loss on the same parameters found out that total food restriction with 50% honey feeding compared with total food restriction with 50% dextrose feeding causes a greater reduction in fasting blood glucose, haemoglobin, aspartate aminotransferase (AST), alanine aminotransferase (ALT), and triacylglycerol and increases serum albumin, serum protein.

They concluded that honey feeding during total food restriction significantly modifies and ameliorates biochemical and haematological changes observed after acute blood loss. This will pave the way to use honey as part of bleeding management and during a food restriction regimen.

Though widely believed to alleviate allergies, local honey has been shown to be no more effective than placebos in controlled studies of ocular allergies (Al-Waili, 2004). This may be because most seasoned allergies are by tree and grass pollens, which honeybees do not collect. However, Ishikawa (2008) in a study showed that pollen collected by bees to exert an anti-allergic effect, mediated by an inhibition of IgE immunoglobin binding to mast cells inhibits mast cell degranulation and thus reduced allergic reaction. Since honey is widely used irrespective of the type, we aimed at studying its effect on the histology of the liver of adult Wistar rats after consumption of honey for eight weeks. The study was approved by the Ethics and Research Committee of the Faculty of Basic Medical Sciences, College of Health Sciences, Delta State University, Abraka. Nigeria.

Materials and Methods

Honey sample: The honey used was purchased from A & Shine International Limited, Abuja, Nigeria (undiluted, no artificial flavours or colours, no preservatives added) with National Agency for Food, Drugs, Administration and Control of Nigeria (NAFDAC) Registration No. 01-6025.

Animals: Twenty adult Wistar rats, between 170 and 200 grams in weight were used for this study. They were divided into four groups of five rats each. Daily consumption of 0%, 20%, 30%, and 40% of honey were mixed with 100, 80, 70 and 60 grams of animal chow in feeding the rats in groups I, II, III and IV respectively for eight weeks. The rats were sacrificed and liver tissue samples were collected for histological analysis.

The liver tissues from each group were fixed in 10% formal saline fluid and processed for histological studies using haematoxylin and eosin stains. Photomicrographs were taken using digital microscope eyepiece SCOPETEK DCM 500, 5.0 mega pixels.

Results

The results obtained are shown in plates I-IV.

Microscopic examination of the liver

Plate I (Group I – control) shows the normal arrangement of the parenchyma of the liver. The sinusoids are radially arranged from the central vein. Hexagonal shape of the hepatocytes is maintained with viable hepatic cells. Normal outline of the central vein can be clearly visualised.

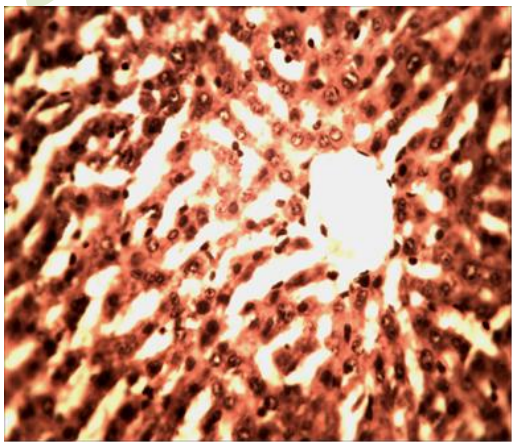

Plate I: Coronal section of liver.
Group I (Control 0% of Honey)
H & E Stain. X 400

Plate II (20% honey) shows distortion of the arrangement of parenchyma of the liver. There is loss of radial arrangement of sinusoids from the central vein of the liver. The hexagonal shape of the hepatocytes is distorted with evidence of hepatic necrosis characterized by pyknotic and karyorrhexic cells. There is also desquamation of the central vein.

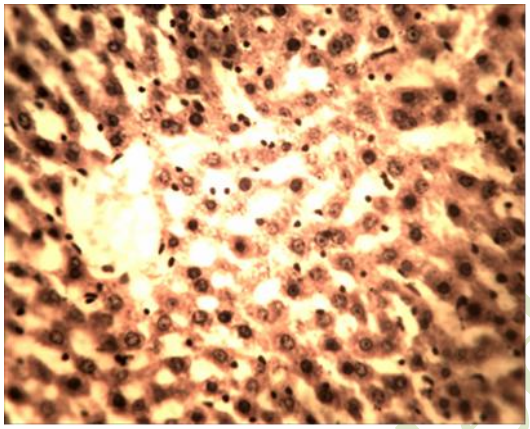

Plate II: Coronal section of liver of Wistar rats.
Group II (20% of Honey)
H & E Stain. X 400

Plate III (30% honey) shows 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 pyknotic, karyolytic and karyorrhexic cells. The central vein of the liver is severely desquamated.

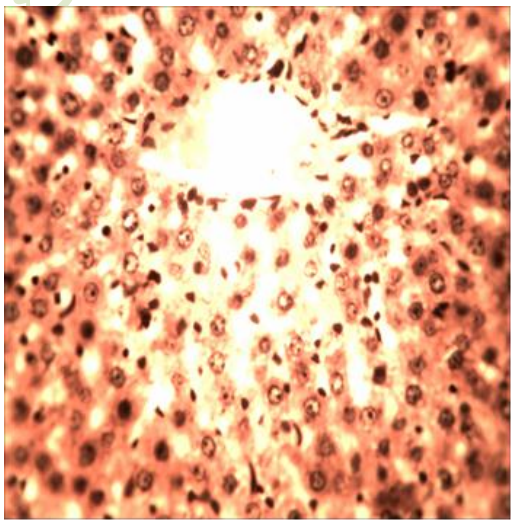

Plate III: Coronal section of liver of Wistar rats.
Group III (30% of Honey)
H & E Stain. X 400

Plate IV (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. The wall of the central vein of the liver is severely desquamated. There is evidence of irreversible cell death.

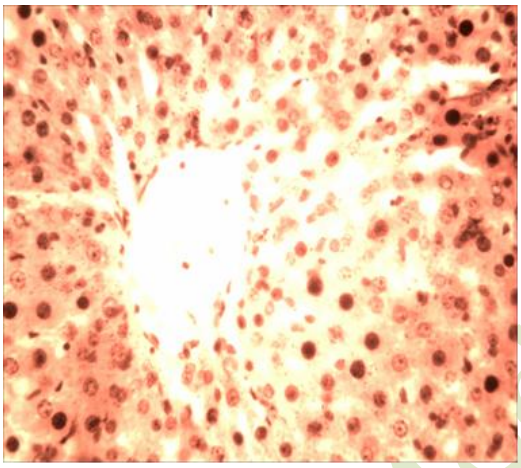

Plate IV: Coronal section of liver of Wistar rats.
Group IV (40% of Honey)
H & E Stain. x 400

Discussion

The distortion of the radial arrangement of the sinusoids from the central vein, the distortion of the hexagonal shape of the hepatocytes with evidence of hepatic necrosis characterized by karyolytic and karyorrhexic cells and the desquamation of the wall of the central vein of the liver may be due to the cleaving of sialic acid by the enzyme sialidase from the haemoglobin-free erythrocytes, plasma and the liver, thus exposing the liver to the damage noticed.

In our recent study on the correlation of liver and blood reduced glutathione levels and neutrophil cell count in honey fed Wistar rats, we observed reductions in blood GSH levels and in neutrophil cell count as well as increase in white blood cell differential count in a dose dependent manner. We concluded that honey might reduce blood GSH level (Umukoro et al., 2009).

These findings are in contrast with the findings of Erguder et al. (2008) 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.

Acknowledgement

We thank Dr. B. Danborno and J. Timbuak for their contributions.

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