Effect of Sucrose and Date (Phoenix dactylifera) on Blood Sugar, Lipid Profile and Liver Function of Normal Wistar Rat

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Abstract

This research aimed at determining the effect of sucrose and date (Phoenix dactylifera) extract in normal male wistar rats. The date extract was processed by drying, grinding and extracting with water while table sugar was merely dissolved in water to obtain 10 Brix respectively. Fifteen (15) male wistar rats of 9-10 weeks old were grouped into three groups of five rats per group. Group A (control) was fed regular rat feed and water, Group B was fed regular rat feed and sucrose solution, while Group C was given regular rat feed and date extract. The weight and the fasting blood sugar of the animals were taking at baseline and also weekly and every two weeks respectively. Daily food and water intake were recorded and the experiment lasted for four weeks when the plasma glucose concentration, glycosylated heamoglobin, serum lipid profile, liver function, and
histopathology of the liver were determined. Feed intake of the control group was significantly higher than that of the other groups while sucrose and date extract consumption of the other two groups were significantly higher than water intake of the control group. Groups given sucrose and date extract had significant weight gain compared to the control group. Sucrose significantly increased the plasma concentration, glycosylated haemoglobin, low density lipoprotein (LDL), total cholesterol and triglyceride but decreased high density lipoprotein (HDL) of the rats. While cholesterol, HDL, LDL, and triglyceride were not significantly different for the control and the group given date extract. There was no significant difference in the aspartate aminotransferase (AST), alanine aminotransferase (ALT) and liver weight. The histopathology showed that both sucrose and date had adverse effect on the liver structure with sucrose having more pronounced effect on the liver compared to date. Date may be a better substitute to sucrose in terms of effect on blood sugar, lipid profile and histopathology of the liver.

**Keywords:** Sucrose, Date, Blood sugar, Lipid profile, Liver

### 1. Introduction

Sucrose is a caloric sweetener which is composed of fructose and glucose and found in substantial amounts in sugar cane and beets. Sucrose is not an essential component of human food and its consumption has remained low throughout the prehistory and middle age. Sucrose consumption in Europe increased essentially during the nineteenth century, and presently represents 10-25% of total energy intake in most parts of the world. Sweetened beverages are major contributors to sucrose intake, and represent up to 10% total energy in North America (Vos *et al*., 2008; Malik *et al*., 2002).

It has long been noticed that high-sucrose intake may have adverse health effects. In animal experiment, it was found that consumption of a high-sucrose diet led to the development of obesity, insulin resistance, diabetes, dyslipidemia, fatty liver, and high blood pressure (Bizeau and Pagliassotti, 2005). Therefore, there is a need for sugar (sucrose) substitutes, which can help reduce caloric intake, particularly in overweight individuals (Sardesai *et al*., 1991).

The demand for new alternative “low calorie” sweeteners for dietetic and diabetic purposes has increased worldwide. As of mid-2002, over 100 plant-derived sweet compounds of 20 major structural types had been reported, and were isolated from more than 25 different families of green plants. Several of these highly sweet natural products are marketed as sweeteners or flavouring agents in some countries as pure compounds, compound mixtures, or refined extracts (Kim and Kinghorn, 2002).

Date fruit also known as *Phoenix dactylifera* are relatively cheap and are significant component of diet in the majority of the Arab countries. The importance of date fruits in human nutrition comes from its rich composition of carbohydrate (65-80%), on dry weight basis mostly of inverted form i.e glucose and fructose (Lambiote, 1982) while also been a rich source of salt and minerals, dietary fiber, vitamins, fatty acids, and protein. Research proves that when dates are eaten alone or as mixed meals with yoghurts they have low glycemic index (Al-Shahib and Marshal, 2003 and El-Belyagy *et al*., 2009).

Various types are found worldwide mainly khodry, khalas, Ruthana, Sukkary, Sefri, Segae, Ajwa, Hilali and Munfi and each types of date has shown medicinal value in various types of disease prevention. Date and their constituents show a role in disease prevention through anti-oxidant, anti-inflammatory and anti-bacterial activity. Anti-oxidant activity is due to the wide range of phenolic compound present in date including p-coumaric. Ferulic, and sinapic acid, flavonoids, sterols, carotenoids and procyanidins (Vayalil *et al*., 2012).

Studies have shown that dates and their aqueous extracts demonstrates free radical scavenging activity, inhibition of free radical-mediated macromolecular damages, antimutagenic, and immunomodulatory activities (Vayalil, 2002; Al-Farsi *et al*., 2005; Allaith, 2008; Saafi *et al*., 2009).
Thus, this research was conducted to determine the effect of sucrose and date (*Phoenix dactylifera*) on blood sugar, lipid profile and liver function of normal wistar rats.

2.0. Materials and Methods

2.1. Collection of Materials

Dried date fruit was obtained from Idiroko in Ogun State and sucrose (table sugar) was bought from Ilishan –Remo market. Male albino rats weighing 115-135 g and aged 9-10 weeks were obtained from Babcock University animal facility and other materials used were appropriately sought for.

2.2. Preparation of Dried Date into Extract

The date was sorted and the seed was removed from the fruit followed by washing and drying in the hot air oven at 80 °C for 3 hours. After cooling, the date was grinded and thirty grams was weighed into the conical flask and 200 ml of water was added. The conical flask was gently shaken for about three minutes in order to ensure proper mixing after which it was left for about 30 minutes before sieving with a muslin cloth. The Brix level of the date extract was checked with the use of handheld refractometer, and the 30 g of date to 200 ml of water gave 10 °Brix which was within the range for fruit juices and soft drinks (Oti, 2016). Date extract was prepared every three days and stored in the refrigerator.

2.3. Preparation of Sucrose Solution

Sucrose solution for the experiment was prepared by dissolution of 25 g of sucrose in 200 ml of water to give 10 °Brix solution. Refractometer was used to determine the °Brix and the solution was prepared every three days.

2.4. Animal Studies

The experiment was carried out at Babcock University Animal Facilities, Ilishan-Remo Ogun State. A total of 15 male wistar rat which were 9-10 weeks old were housed in cages at the room temperature of 28 ±2 °C and 12- hours artificial light period for 7 days for acclimatization and were allowed free access to regular rat pallet (Reeves et al.1993). The same condition of temperature and light was also maintained during the experiment. Rats were randomly divided into three groups (n=5) of one control group and two treatment groups. The control group A was given regular rat feed with water, while group B was on regular feed with sucrose solution and group C was fed regular rat feed with date extract. The sucrose solution and date extract served as water for the rats in group B and C. The duration of the experiment was four weeks.

Fasting blood sugar was determined at the beginning (baseline) and every two weeks during the period of the experiment using a glucometer. Food and water were withdrawn 12 h before determination of fasting blood sugar. The weight of the animals was taken weekly and their daily food and water intake were recorded. At the end of the experiment, animals were fasted for 12 h and blood samples were collected from the eye for determination of lipid profile, plasma glucose, glycylated haemoglobin and liver function test. The blood samples were collected into heparin bottles and fluoride oxalate bottles respectively. The blood was centrifuged to separate the supernatant which was kept in plain bottles and refrigerated until it was required for use. The rats were rendered unconscious by the means of cervical dislocation and liver samples were collected and preserved in 10 % formalin solution for histopathology analysis.
2.5. Analyses

2.5.1. Fasting Blood Sugar
Accu-chek glucometer was used to determine the fasting blood sugar of the rats. They were fasted overnight for 12 hours and the tip of the rat tail was snipped using scissors (sterilized with spirit) in order to let out blood from the tail vein. Blood from the rat tail was dropped on the strip in the glucometer and the blood sugar reading was noted and recorded (Roche Diabetes Care).

2.5.2. Plasma Glucose Concentration
The test was carried out using the GOD-PAP method described in the kit manufacturer’s manual (Randox Laboratory Limited) for determination of plasma glucose concentration. All reagents used for the analysis were maintained at room temperature. The content of one vial of the reagent, R1b was reconstituted with a portion of buffer R1a to form R1. Clean and dried test tubes were properly labelled and placed in a test tube rack. Reagent R1 (1000 µl) was introduced into all the test tubes and the test tube labelled ‘blank’ had only reagent R1. Reference standard solution (10 ul) was added to the test tube labelled ‘standard’ and 10 µl of the various blood samples was pipetted into their corresponding test tubes. The various solutions were properly mixed and left to incubate at 37 °C for 10 minutes. Absorbance of the standard (A_{standard}) and the sample (A_{sample}) was measured against the reagent blank within 60 minutes.

\[
\text{Glucose concentration mmol/L} = \frac{A_{sample}}{A_{standard}} \times \text{standard conc. (mmol/L)}
\]

\[
\text{Mg/dl} = \frac{A_{sample}}{A_{standard}} \times \text{standard conc. (mg/dl)}
\]

2.5.3. Glycosylated Hemoglobin
The method was as described in the Spectrum glycosylated hemoglobin kit manual (Spectrum, Egypt). To prepare hemosylate, Lysing reagent (0.5 ml) was added to the tubes labelled control (C) and test (T). The reconstituted control (0.1 ml) and well mixed blood sample was added to the appropriately labelled tubes. The solution was mixed until complete lysis was evident and the mixture was allowed to stand for 5 minutes.

In separation of glycosylated hemoglobin (GHb), the caps of the ion-exchange tubes were removed and tubes were labelled control (C) and test (T). Hemosylate (0.1 ml) was added into the appropriately labelled ion exchange tube. A resin separator was inserted into each tube so that the rubber sleeve is approximately 1 cm above the liquid level of the resin suspension and the tubes were mixed on a rotator continuously for 5 minutes. The resin was allowed to settle, and then the resin separator was pushed into the tubes until the resin was firmly packed. The supernatant fluid was poured directly into a cuvette and each absorbance in a spectrophotometer at 546 nm was measured against distilled water.

To determine total hemoglobin fraction (THb), five millilitre of distilled water was dispensed into tubes labelled T and C and 0.02 ml of the hemolysate was added into the appropriately labelled tubes. The solution was properly mixed and each absorbance was read against distilled water.

\[
\text{Ratio of control (R_C)} = \frac{\text{AbsTest GHb}}{\text{AbsTest THb}}
\]

\[
\text{Ratio of test (R_T)} = \frac{\text{AbsTest GHb}}{\text{AbsTest THb}}
\]

\[
\text{GHb in %} = \frac{\text{Ratio of Test (RT)}}{\text{Ratio of Control (R_C)}} \times 10(\text{value of control})
\]
2.5.4. Lipid Profile Test

2.5.4.1. Serum Cholesterol
Clean and dried test tubes were properly labelled as tests, standard and blank. The test tubes were put on a rack and 1000 µl of the cholesterol reagent was measured into all the test tubes. Into the test tube labelled blank, 10 µl of distilled water was added, 10 µl of the reference standard was measured into the test tube labelled standard and 10 µl of the blood sample was then added to the other test tubes excluding the standard and the blank test tubes. The content of the various test tubes were properly mixed and thereafter incubated for 10 minutes at 25 °C. The content of each test tube was poured into a cuvette and the absorbance (546 nm) of the sample was measured against the reagent blank within 60 minutes (Randox Laboratories Limited).

\[ \text{Conc. of cholesterol in sample} = \frac{\Delta A_{\text{sample}}}{\Delta A_{\text{standard}}} \times \text{conc. of standard} \]

2.5.4.2. Serum HDL Cholesterol
Properly labelled, clean and dried centrifuge tubes were placed on the rack and 500 µl of the diluted precipitant R1 was pipetted into all the test tubes. Standard solution (200 µl) was pipetted into the test tube labelled as standard and 200 µl of the blood samples was added to their respective test tubes. The content of each test tube was mixed and allowed to sit for 10 minutes at room temperature. The content of the tubes were centrifuged for 10 minutes at 4,000 rpm (revolution per minute). The clear supernatant fluid was separated and cholesterol content was determined using the CHOD-PAP method.

For cholesterol CHOD-PAP assay, cholesterol reagent (1000 µl) was pipetted into clean, dry and properly labelled test tubes and 1000 µl of the standard supernatant was added to the content of the test tube labelled as standard. Also, 100 µl of the sample supernatant was pipetted into their correspondingly labelled test tube and 100 µl of distilled water was added to the test tube labelled blank. The content of the various test tubes was mixed and incubated for 10 minutes at 25 °C. The absorbance of the sample (A_{\text{sample}}) and standard (A_{\text{standard}}) was measured against the reagent blank within 60 minutes (Randox Laboratories Limited).

\[ \text{Concentration of HDL cholesterol in supernatant (mg/dl)} = \frac{\Delta A_{\text{sample}}}{\Delta A_{\text{standard}}} \times \text{conc. of standard} \]

2.5.4.3. LDL Cholesterol
The calculation of LDL cholesterol (mg/dl) was according to the Randox laboratory manual for determination of serum LDL cholesterol.

\[ \text{LDL Cholesterol} = \text{Total cholesterol} - \frac{\text{Triglycerides}}{2.2} - \text{HDL Cholesterol} \]

2.5.4.4. Serum Triglycerides
The test was carried out using the CHOD-PAP method for determination of serum triglyceride (Randox laboratories limited). The content of R1b was reconstituted with a portion of buffer R1a to form R1. The entire content of bottle R1b was transferred to R1a, rinsing vial R1b several times. Clean and dried test tubes labelled as standard, blank and tests (for blood samples) were arranged on a test tube rack.

Reagent R1 (1000 µl) was pipetted into all the test tubes followed by addition of 10 µl of the standard solution into the test tube labelled standard and 10 µl of the various blood samples into the rest of the test tubes excluding the test tubes labelled blank and standard. The content of each test tube was properly mixed and incubated at 25 °C for 10 minutes. The absorbance (546 nm) of the sample (A_{\text{sample}}) and standard (A_{\text{standard}}) was measured against the reagent blank within 60 minutes.

\[ \text{Triglyceride concentration (mg/dl)} = \frac{A_{\text{sample}}}{A_{\text{standard}}} \times \text{standard conc. (mg/dl)} \]
2.5.5. Liver Function Test
Activity of Alanine aminotransferase and Aspartate aminotransferase were determined in liver function test. Clean and dried test tubes were properly labelled as blank and samples and 0.5 ml of solution R1 was pipetted into all the test tubes. Distilled water (0.1 ml) was pipetted into the test tube labelled blank and 0.1ml of the various blood samples was put in their appropriate test tube. The content of the various test tubes was properly mixed and incubated for exactly 30 minutes at 37 °C.

After incubation, 0.5 ml of solution R2 was added to all the test tubes. The content of the various test tubes was mixed and allowed to stand for exactly 20 minutes at 25 °C. Five millilitre of sodium hydroxide was dispensed into all the test tubes and the content of the test tube was mixed. The absorbance of the samples was read against the reagent blank after 5 minutes using a spectrophotometer.

The activity of serum Alanine aminotransferase (ALT) and Aspartate aminotransferase (AST) was obtained from the table provided for determination of (ALT) and Aspartate (AST) in serum (Randox Laboratory Limited).

2.5.6. Liver Histopathology
Histological test used was Hematoxylin and Eosin Staining Procedure (Sheehan and Hrapchak, 1987). Deparaffinise slides were placed in xylene solution which was changed three times within 3 minutes. Tissue sections were hydrated by subjecting them through decreasing concentration of alcohol (100 % alcohol and 95 % alcohol), two changes in 3 minutes each and afterwards were rinsed in distilled water until ripples disappeared from the slides. The slides were then placed in hematoxylin for 8-15 minutes. After the hematoxylin staining, the slides were washed under running water till the water was clear.

The slides were put into 1% hydrochloric acid alcohol differentiation liquid solution with 6 quick dips for about 5-30 seconds until the slides got red. It was then rinsed in water for about 15 minutes till a section could be seen blue. After, the differentiation was checked microscopically to see the nuclei that should be distinct and the cytoplasm which should be uncoloured. The tissue sections were then dipped in alkaline solution (Bluing Agent) for about 5 minutes and were later washed in lukewarm water.

The tissues were stained in eosin for 2 minutes and were dehydrated in increasing concentration of alcohol (95% and 100%) with three changes for 2 minutes. The tissues were cleared in three changes of xylene for 2 minutes each and the cover glass was mounted.

2.5.7. Statistical Analysis
All results were recorded as Mean ± S.D. One way analysis of variance (ANOVA) was used to determine significance difference (P<0.05) among the control and the treated group while Duncan multiple range test was used to separate the mean using SPSS version 20.0.

3.0. Results and Discussion
3.1. Results
3.1.1. Mean Feed and Water Intake, and Average Weight Gain
The results of mean feed and water intake, and average weight gain are presented in Table 1. The mean feed intake of the rats for week 1 varied from 84.85±15.70 – 104.57±12.7, week 2 varied from 62.57±11.78 - 110±37.26, week 3 varied from 60.85±8.93-117.00±19.57, and for week 4 the mean range varied from 61.42±9.43 – 93.00±7.48. The water, sucrose and date intake of the animals also varied. For week 1 the mean range was 130.85±36.47-159.71±37.84, for week 2 the mean range was 122.28±23.24- 193.00±28.39, week 3 varied from 116.71±70.39-200.00±22.36 and for week 4 the mean range was 150.00±70.72 – 214.28±16.18. The average weight gain varied from 27.60±8.20 – 32.80±17.60 for all the groups.
Table 1: Mean feed, water, sucrose and date extract intake of the test rats per week and the average weight gain

<table>
<thead>
<tr>
<th>Feed intake</th>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>104.57±12.7</td>
<td>84.85±15.7</td>
<td>85.14±25.70</td>
</tr>
<tr>
<td>Week 2</td>
<td>110.71±37.26</td>
<td>62.57±11.78</td>
<td>78.85±33.37</td>
</tr>
<tr>
<td>Week 3</td>
<td>117.00±19.57</td>
<td>60.85±8.93</td>
<td>62.85±7.90</td>
</tr>
<tr>
<td>Week 4</td>
<td>93.00±7.48</td>
<td>64.85±2.34</td>
<td>61.42±9.43</td>
</tr>
<tr>
<td>Water, sucrose and date extract intake</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Week 1</td>
<td>130.85±36.47</td>
<td>159.71±37.84</td>
<td>152.71±33.59</td>
</tr>
<tr>
<td>Week 2</td>
<td>122.28±23.24</td>
<td>193.00±28.39</td>
<td>184.85±28.06</td>
</tr>
<tr>
<td>Week 3</td>
<td>116.71±70.39</td>
<td>195.00±35.47</td>
<td>200.00±22.36</td>
</tr>
<tr>
<td>Week 4</td>
<td>150.00±70.72</td>
<td>172.00±71.03</td>
<td>214.28±16.18</td>
</tr>
<tr>
<td>Weight gain</td>
<td>27.60±8.20</td>
<td>32.20±16.60</td>
<td>32.80±17.06</td>
</tr>
</tbody>
</table>

Mean in the same row with the same superscript are not significantly different (P<0.05)
Group A: Water (Control)
Group B: Sucrose
Group C: Date

3.1.2. Fasting Blood Sugar (mg/dl)
Fasting blood sugar is presented in Figure 1. The baseline blood sugar of the animals varied from 82.40 ± 10.97 – 101.80 ± 5.40, at two weeks the blood sugar varied from 61.80 ± 8.19 – 93.40 ± 9.29, and at four weeks the blood sugar level varied from 57.60 ± 6.91 – 79.400 ± 13.29.

Figure 1: Fasting blood sugar (mg/dl) of the test animals

3.1.3. Plasma Glucose Concentration and Glycosylated Heamoglobin (HbA1c)
Table 2 present the recorded values for plasma glucose concentration and glycosylated heamoglobin. The mean range for plasma glucose was 82.12 ± 1.53 -118.92 ± 12.55 while the mean range for glycosylated heamoglobin was 4.77 ± 0.03 -5.08 ± 0.04.
Table 2: Plasma Glucose concentration and glycosylated heamoglobin (HbA1c)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
</tr>
</thead>
<tbody>
<tr>
<td>HbA1c (%)</td>
<td>4.77 ± 0.03</td>
<td>5.08 ± 0.04</td>
<td>4.79 ± 0.18</td>
</tr>
<tr>
<td>Plasma Glucose (mg/dl)</td>
<td>82.12 ± 1.53</td>
<td>118.92 ± 15.55</td>
<td>88.34 ± 8.28</td>
</tr>
</tbody>
</table>

Mean in the same row with the same superscript are not significantly different (P≤0.05)
Group A: Water (Control)
Group B: Sucrose
Group C: Date

3.1.4. Serum Lipid Profile
The results of serum lipid profile parameters are presented in Figure 2. The mean for total cholesterol varied from 98.84 ± 0.93 - 120.0 ± 1.83, HDL varied from 22.12 ± 0.73 – 27.99 ± 0.21, LDL varied from 28.33 ± 0.25 – 51.05 ± 1.29 and triglyceride 96.65 ± 2.05 -104.45 ± 1.78.

![Figure 2: Lipid profile of the test animals](image)

Group A: Water (Control)
Group B: Sucrose
Group C: Date

3.1.5. Liver Function Test and Weight of the Liver
Table 3 represent the recorded values of the liver function test and the weight of the liver. The mean range for the liver function test varies. For the AST the mean range was from 61.36 ± 2.47 – 61.78 ± 2.77, for ALT the mean varied from 4.91 ± 1.09 - 6.40 ± 0.00. The weight of the liver ranged between 4.52 ± 0.15 – 5.34 ± 0.67.

Table 3: Liver function and weight of the liver

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
</tr>
</thead>
<tbody>
<tr>
<td>AST</td>
<td>61.78 ± 2.77</td>
<td>61.39 ± 1.13</td>
<td>61.36 ± 2.47</td>
</tr>
<tr>
<td>ALT</td>
<td>5.85 ± 1.99</td>
<td>6.40 ± 0.00</td>
<td>4.91 ± 1.09</td>
</tr>
<tr>
<td>Weight of liver</td>
<td>4.52 ± 0.15</td>
<td>5.18 ± 1.04</td>
<td>5.34 ± 0.67</td>
</tr>
</tbody>
</table>

Mean in the same row with the same superscript are not significantly different (P≤0.05)
Group A: Water (Control)
Group B: Sucrose
Group C: Date
AST: Aspartate aminotransferase
ALT: Alanine aminotransferase
3.1.6. Histology of the Liver

![Histology Result](image)

Photomicrograph of the liver: The control group shows a normal histoarchitecture with the hepatocytes well delineated while the sucrose group presents a highly congested central vein and enlarged sinusoids when compared with the control group. Date group reveals a better histology though the central vein not completely void at X400 while its portal vein shows a complete occlusion at X100. CV = central vein; H = hepatocyte; D = bile duct; PV = portal vein; A = hepatic artery. H&E X 100 above and X400 below.

3.1. Discussion

Feed, water, sucrose and date extract intake (Table 1) showed that the control group placed on regular diet and water had the highest consumption of feed which was significantly higher than what was consumed by the groups on sucrose and date extract respectively. But the water intake of the group was significantly low when compared to the other groups. Despite that the control group had high consumption of feed, the weight gain of the other two groups were significantly higher with average consumption of sucrose and date being 0.022, 0.028, 0.026, 0.020 mg/g bodyweight and 0.036, 0.043, 0.045, 0.043 mg/g bodyweight of the rats in the first, second, third and fourth weeks of the experiment respectively.

This finding corroborate earlier and established findings of sucrose increasing the tendency for obesity (Bizeau and Pagliassotti, 2005; Manickavasagan et al., 2013). The significant increase in the weight gain of animals given date extract could be as a result of date been a rich source of carbohydrate which is majorly glucose and fructose (Lambiotte, 1982). Also, consumption of fluid in form of date extract was significantly higher than the control group on water.

The blood sugar of the animals measured at baseline showed the blood glucose of the control group to be significant higher than the blood glucose of the sucrose and date extract group. However, by fourth week the blood glucose of the sucrose group was higher and significantly different (P < 0.05) though the fall in the blood sugar of the test rats during the experiment was incomprehensive. But this observation in the trend of the blood sugar of the animals at fourth week can be further explained by the plasma concentration and the glycosylated haemoglobin of the test animals. The plasma concentration (118.92±12.55 mg/dl) and the glycosylated haemoglobin (5.08 ± 0.04 %) of the sucrose group was significantly higher than the control and date extract group and was beyond the normal range which indicate that the group has propensity for the development of diabetes. However, the plasma glucose (88.34 ± 8.28) and the glycosylated haemoglobin (4.79 ± 0.18) of the date group was in close range with that of the control. This finding is supported by earlier findings of deleterious effect of sucrose on blood sugar (Bizeau and Pagliassotti, 2005; Tappy and Le, 2010) and positive effect of date on the blood sugar (Gourchala and Henchiri, 2013).

The lipid profile showed a significant (P< 0.05) increase in the total cholesterol, LDL and triglycerides with a significant reduction in HDL of the sucrose group. While there was close
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comparison in the cholesterol, LDL, HDL and triglycerides of the date group and the control. Increase in the parameters of lipid profile of sucrose group may be as a result of metabolic pathway of carbohydrate in which excess glucose is converted to fat. However, positive effect of date on lipid profile found in this work is also been substantiate by the report of Gourchala and Henchiri (2013) and Rock et al. (2009) who reported decrease in LDL and triglyceride by date consumption in human subjects.

Aspartate aminotransferase (AST) and alanine aminotransferase (ALT) were analysed for liver function because of their involvement in metabolism. It was found that there was no significant different (P< 0.05) between all the groups which is an indication of absence of metabolic abnormalities in the liver of the test animals as elevation of these enzymes indicates metabolism abnormalities (Perera et al, 2008). Also, there was no significant difference in the liver weight of the test animals though liver of the group given sucrose and date extract weighed more than the control.

Histopathology of the liver of the test rats revealed a normal structure of the liver of the control group with well delineated hepatocytes. While in the group given sucrose there was highly congested central vein with enlarged sinusoid and for the group on date extract the central vein was not seriously affected though the portal vein was totally blocked. However, the date group presented better histology compared to the sucrose group, a finding that is supported by earlier report of Saafi et al (2011) on the improvement of liver histology by date as a result of oxidative damage. It is necessary to mention that by calculation, the amount of sucrose and date administered to the rat was above 4,400 calories for 50 kg man recommended by WHO (2015), 50 g per day (200 calories) by FDA (2016) and 100 to 150 calories per day for humans recommended by AHA (2018).

4.0. Conclusion

Sucrose and date fruit contributed to the weight gain of the test animals and sucrose significantly increased the glycosylated heamoglobin of the animals. Cholesterol, LDL, HDL, and triglyceride levels were similar amongst the control rats and rats fed date extract. Sucrose caused a decrease in the HDL and an increase in the LDL, total cholesterol and triglyceride. Both sucrose and date had adverse effect on the liver with sucrose having a more significant effect.

**Ethical approval:** Ethical approval was obtained from Babcock University Health Research Ethics Committee.

References


[16] Randox Laboratories Limited 55 Diamond road Crumlin County Antrim United Kingdom www.randox.com


