



Effect of the Golden Liquid from Honeybees and Refined Granulated Sugar on the Blood Glucose and Serum Iron Levels of Albino Rats

B. U. Ononye ^{a*}, C. T. Udeagulu ^a, C. E. Akunne ^a,
K. C. Onyewuchi ^b, K. C. Mbelede ^a, C. A. Chidi ^a,
O. C. Ekwebene ^c, F. C. Akubukor ^d, K. P. Okafor ^a,
I. Offorbuike ^a, S. E. Ayaegbunam ^a and I. E. Obiefule ^e

^a Department of Zoology, Nnamdi Azikiwe University, Awka, Nigeria.

^b Department of Applied Biochemistry, Nnamdi Azikiwe University, Awka, Nigeria.

^c Department of Internal Medicine, Nnamdi Azikiwe University Teaching Hospital, Nnewi, Anambra State, Nigeria.

^d Department of Medicine, Nnamdi Azikiwe University, Awka, Nigeria.

^e Department of Parasitology and Entomology, Nnamdi Azikiwe University, Awka, Nigeria.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

This study investigated the effect of the golden liquid from honeybees (natural honey) and refined granulated sugar on the blood glucose and serum iron levels of Wistar albino rats. The experimental animals used in this study were grouped into five treatments based on the dose of

*Corresponding author: Email: bu.ononye@unizik.edu.ng, ononyeb@gmail.com;

natural honey and refined granulated sugar administered namely: T1 (1.02 g of honey /kg BW), T2 (1.40g of honey /kg BW), T3 (1.02 g of refined granulated sugar /kg BW), T4 (1.40g of refined granulated sugar /kg BW) while rats in T5 not administered with honey and refined granulated sugar served as the control. The blood glucose concentration of the albino rats was measured using the glucose strips with glucometer while the serum iron analysis was conducted using Atomic Absorption Spectrophotometer. The result revealed that the mean blood glucose level of the rats was highest in T3 (112.95mg/dl), followed by T5 (92.20mg/dl) while the least value was recorded in T2 (74.86mg/dl). There was significant difference in the blood glucose levels of albino rats orally administered natural honey and refined granulated sugar at varying levels ($P<0.05$). The result also showed that the mean blood glucose level of the albino rats was significantly different at week 2 and week 3 ($P<0.05$). The highest serum iron level was recorded in T5 (1.31ppm) followed by T2 (1.22 ± 0.115 ppm), while the least serum iron level was recorded in T1 (0.88ppm). However, there were no significant differences in the serum iron levels of the albino rats ($p>0.05$) among treatments. The use of natural honey is recommended since, albino rats orally administered honey at varying doses had lower blood glucose level than those given refined granulated sugar.

Keywords: Blood glucose; serum iron levels; albino rats; natural honey; refined sugar.

1. INTRODUCTION

Honey is a naturally sweet substance produced by honeybees from water, pollen, and nectar [1]. Most beekeepers harvest honey, which is then consumed by people because of its apitherapeutic and nutraceutical properties [2,3]. Honey contains carbohydrates with very little protein, vitamins, minerals, enzymes, amino acids, and phenol compounds [4,5]. Natural honey's biochemical makeup and physical characteristics differ substantially depending on the plant species that honeybees forage on [6] as well as on the differences in climatic conditions and vegetation of the areas [7].

Due to its unique nutritional and therapeutic benefits, which are ascribed to the interaction of the various chemical groups it contains, natural honey is one of the most popular products [8]. In the past, doctors have used honey to treat patients' illnesses because it contains both enzymatic and non-enzymatic antioxidants [9, 10]. It is abundant in minerals like magnesium, potassium, calcium, phosphate, sulphur, and sodium chloride as well as vitamins like B1, B2, B5, B6, and C. It also contains fructose and glucose. [11]. As a result of the nutritional composition of natural honey, it is used as a replacement for many other sweeteners such as refined sugar/granulated sugar.

Refined Granulated Sugar (RGS) typically refers to a class of simple carbohydrates that comprises fructose and glucose as monosaccharides and sucrose and lactose as disaccharides [12]. Over the past few years, there has been a noticeable increase in public

awareness of the metabolic and related health implications of excessive sugar consumption [13]. In order to reduce the risk of obesity and unhealthy weight gain, the World Health Organization advises cutting sugar consumption to less than 5% of daily caloric intake [12]. The American Academy of Paediatrics recommended that parents should avoid giving infants under one-year olds fruit juice that contains a high concentration of refined granulated sugar [14]. Refined granulated sugar has been identified as one of the obesities and metabolic syndrome risk factors that raises the risk of cardiovascular disease, type 2 diabetes, and non-alcoholic fatty liver disease. The metabolic syndrome is a group of risk factors that includes high blood pressure and high fasting blood glucose [15].

Modern day individuals consume a lot of refined granulated sugar, either directly through foods or indirectly from other sources. [12]. The consumption of large amount of refined granulated sugar alters haematological and physiological changes in human body system [16]. According to several scientific studies, honey can be used as a healthier alternative to refined granulated sugar because it does not pose threats to human health [17]. Depending on the food substance consumed, the blood level fluctuates from its regular state when food elements are ingested. Iron, calcium, and potassium are just a few of the many micronutrients found in honey that improve blood circulation in humans. Consuming natural honey raises serum iron levels and red blood cell counts since it is known that the iron in honey serves as a precursor to hemoglobin [18].

According to Erejuwa, [19], administration of natural honey increased serum levels of insulin while it reduced serum concentrations of glucose and fructosamine in diabetic rats. In comparison with refined sugar, honey reduce weight gain and adiposity, presumably due to lower food intake and also promote lower serum triglycerides [20]. There is need to assess the effect of natural honey on the blood glucose and serum iron levels of non-diabetic rats [21,22]. Hence, this study was carried out to determine the effect of natural honey and refined granulated sugar on blood glucose and serum iron level on albino rats in Awka, Anambra State.

2. MATERIALS AND METHODS

2.1 Study Area

The study was carried out in the Animal House of the Department of Biochemistry, Nnamdi Azikiwe University, Awka, Nigeria. The experimental site lies between latitude 6° 15' 18.06" N and longitude 7° 06' 41.37" E. Awka is town is located on latitudes 6°9'19"N 7°07'12"E and stretches 8 km in an east-west direction along the Enugu-Onitsha expressway and about 5 km in a North-south orientation [23].

2.2 Source of Experimental Materials

Twenty-five (25) healthy albino rats with mean weights ranging from 41.21±1.247g to 47.27±1.769g were used in the study which was purchased from Mr. Onyewuchi farms in Awka, Anambra State. The albino rats were carefully transferred to the Animal House of the Department of Biochemistry, Nnamdi Azikiwe University, Awka, where the experimental animal was housed for the whole period of the experiments. The refined sugar (Dangote granulated sugar) used for this study was used for the experiment was purchased from Eke-Awka market, Awka Anambra State while the natural honey was obtained from processing freshly harvested honeycombs by beekeepers at Uzoben Integrated Services, Awka Anambra State.

2.3 Management of Experimental Animals

The albino rats were kept under close supervision in a makeshift metal cage. Four albino rats were kept in each cage, which measures 1 meter in length, 0.5 meters in width, and 1 meter in height. The floor was composed of tin metal coated with sawdust, and the tops of

the cages were covered with wire to allow for sufficient ventilation. The albino rats were kept in same hygienic conditions throughout the trial, leaving the nutritional additions as the only source of change. Also, for a month, the albino rats received clean water every day from 9 am to 12 pm.

2.4 Experimental Design

The experimental rats were marked at the head, abdomen, center, neck, and tail for simple identification. The albino rats were divided into five treatment groups based on the dosage of natural honey and granulated sugar, namely: T1 (1.02g of honey /kg BW), T2 (1.40g of honey /kg BW), T3 (1.02g of refined granulated sugar /kg BW), and T4 (1.40g of refined granulated sugar /kg), with rats in T5 serving as the control group and not receiving honey or refined granulated sugar. An entirely random design was used to set up the experiment. Five albino rats were used in each treatment.

2.5 Glucose Content Determination

The weekly blood glucose level of the albino rats was measured using the glucose strips with glucometer. A puncture was made on the tail to collect the blood sample. A drop of blood was applied to a chemically active disposable test strip on which the chemical reaction occurred due to the action of glucose deoxyreductase that resulted in color change. Glucometer verified this colour change and showed glucose level. At the same time, a drop of capillary blood, (drawn from the heel) was sampled and applied to the test strip to measure level of glucose. Before sampling, the heel was warmed up by hand massage followed by disinfecting the spot, and then blood sample was taken [24].

2.6 Serum Iron Analysis

Serum iron analysis was conducted using Varian AA240 Atomic Absorption Spectrophotometer according to the method of APHA 1995 (American Public Health Association) as reported by Lopes et al. [25].

2.7 Statistical Analysis

The data obtained from the study was recorded using Microsoft Excel, 2019. The data on the blood glucose and serum iron levels in the five treatments was subjected to Analysis of Variance (ANOVA. Turkey Honest Significant Difference (HSD) test was used to separate means using

IBM SPSS statistics version 23 at 5% significance.

3. RESULTS

The result in Table 1 showed the weekly blood glucose levels of albino rats orally administered natural honey and refined granulated sugar. The result revealed that the mean blood glucose level was highest in T3 (112.95mg/dl), followed by T5 (92.20mg/dl) while the least value was recorded in T2 (74.86mg/dl). There was significant difference in the blood glucose levels of albino rats orally administered natural honey and refined granulated sugar at varying levels (P<0.05).

The result obtained at week 1 showed that the mean blood glucose level was highest in T3(97.70mg/dl) while T2 (70.95 mg/dl) had the least. At week 2, the mean blood glucose level was highest in T3(144.95mg/dl) while T1 (84.700mg/dl) recorded the least. The result obtained at week 3 revealed that mean blood glucose level was highest in T1(104.70mg/dl) while T2 (68.45mg/dl) recorded the least.

There was significant difference in the weekly blood glucose levels of albino rats orally administered natural honey and refined granulated sugar at week 2 and week 3 (P<0.05) except week 1 (P>0.05).

The result from Table 2 showed that the highest serum iron level was recorded in T5 (1.31±0.395 ppm) followed by T2 (1.22± 0.115 ppm), while the least serum iron level was recorded in T1 (0.88±1.319ppm). It was observed that there were no significant differences in the serum iron

levels of the albino rats (p>0.05) among treatments.

4. DISCUSSION

Findings of the study indicates that natural honey does not significantly increase the blood glucose level of albino rat as refined granulated sugar does. This indicates that natural honey is better than refined sugar and safe for consumption especially by diabetic patients [26]. This finding supports the report by Bobiş *et al.* [27] who reported that honey may provide nutritional benefits in the management of diabetes mellitus. This also supports the observation by Adekanmbi *et al.* [11] who reported that honey is rich in fructose, glucose, and minerals such as magnesium, potassium, calcium, phosphate, sulphur, ferrous, and sodium chloride as well as vitamins such as B1, B2, B5, B6, and C. As a result of the rich nutrients in honey, Ononye *et al* [28] also reported that natural honey should be consumed regularly by humans for efficient performance of the body.

The result also showed that the mean blood glucose level of the albino rats was significantly lower at week 2 and week 3. This observation supports earlier reports by Adesoji and Oluwakemi [29] also revealed that daily ingestion of honey for three weeks progressively and effectively reduced blood glucose level in rats with alloxan induced diabetes.

The findings of this study were in line with previous studies [30,31,20] on the effect of natural honey on regulation of blood glucose level and it benefits in the treatment of type 2 diabetes. Thus, bee honey is useful for diabetic patients as a tasty substance and as a nutritious substance [32].

Table 1. Blood glucose concentration in albino rats orally administered natural honey and refined granulated sugar for a period of three weeks

Treatment	Weekly mean concentration of blood glucose (mg/dl) level ±SD			Mean blood glucose level (mg/dl) ± SD
	Week 1	Week 2	Week 3	
T1	78.20 ^a ±8.871	84.70 ^a ±19.709	104.70 ^b ±23.905	89.20 ^a ±20.808
T2	70.95 ^a ±36.502	85.20 ^a ±22.510	68.45 ^a ±7.098	74.86 ^a ±24.457
T3	97.70 ^a ±22.726	144.95 ^b ±34.956	96.20 ^{ab} ±21.993	112.95 ^b ±34.407
T4	93.70 ^a ±21.058	94.45 ^a ±18.341	87.45 ^{ab} ±16.908	91.86 ^{ab} ±17.749
T5	92.45 ^a ±22.19	94.95 ^a ±21.045	89.20 ^{ab} ±3.962	92.20 ^{ab} ±16.663

Columns sharing similar superscripts are not significantly different (P>0.05)

Table 2. Serum iron concentration of albino rats orally administered natural honey and refined granulated sugar

Treatment	Mean Serum iron level \pm SD
T1	0.88 ^a \pm 1.319
T2	1.22 ^a \pm 0.115
T3	1.04 ^a \pm 0.277
T4	0.99 ^a \pm 0.299
T5	1.31 ^a \pm 0.395

Columns sharing similar superscripts are not significantly different ($P>0.05$)

The result of this study showed that oral administration of honey did not significantly increase the serum iron level. This is in contrast with the work by Erejuwa et al. [33] who reported that honey administration was found to increase serum iron levels in diabetic rats.

5. CONCLUSION

It was concluded that mean blood glucose level of albino rats orally administered natural honey at varying doses was significantly lower than those administered 1.02g of granulated sugar /kg BW. This implies that consumption of natural honey did not significantly increase blood glucose level. It was therefore recommended that natural honey should be used over refined granulated sugar and could be safe for consumption by diabetic patients.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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