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**Effects of Honey on Some Haematological Indices and Lipid Profile in Male Mice**Goji A.D.T.<sup>1</sup>, Tende J.A.<sup>2</sup>, Mohammed, K.A.<sup>1</sup>, Tanko, Y.<sup>2</sup>Department of Human Physiology, College of Medicine, Faculty of Basic Medical Sciences, Kaduna State University, Kaduna, Nigeria<sup>1</sup>, Department of Human Physiology, College of Medicine, Faculty of Basic Medical Sciences, Ahmadu Bello University, Zaria, Nigeria<sup>2</sup>.

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**Abstract**

This study was primarily designed to investigate the effect of acute administration of honey on some haematological parameters and lipid profile parameters of male mice. Fifteen male mice were divided into five groups of three each and were administered with distilled water, 10%, 20%, 50%, and 100% (v/v) of pure honey daily for seven days in that order. On the eighth day the mice were sacrificed and blood samples were collected for analyses. Total cholesterol, HDL, LDL, Triglyceride level and complete blood counts were determined by automatic analyzer. Low density lipoprotein (LDL) and Total cholesterol levels was observed to be higher in the mice treated with 10% (v/v), 20% (v/v), 50% (v/v) and 100% (v/v) compared to the control group ( $p < 0.05$ ). However, HDL levels in mice treated with 10% v/v, 50% v/v and 100% v/v were higher ( $p > 0.05$ ) but 20% (v/v) was slightly lower as compared to the control group. Group 5 [100% (v/v)] was higher as compared to group 2 (10% v/v) and group 4 [50% (v/v)]. Triglyceride levels showed decrease ( $p > 0.05$ ) in the rest of the group as compared to the control group. There was increase ( $p > 0.05$ ) MID (monocyte count) with increasing concentration and increase in Platelet count in Group 2 [10% (v/v)] as compared to the other groups. Hb, PCV and RBCs Count were higher ( $p > 0.05$ ) in Group 2 [10% (v/v)] as compared to the rest of the groups. Results from this study suggest that daily consumption of honey might have some positive effects on haematological indices and triglyceride levels.

**Keywords:** Cholesterol, Lipoprotein, RBC, Honey, Cardiovascular

**Introduction**

Honey is a natural food, and its quality and composition are important for healthy human consumption (Ash, 2018; Bogdanov *et al.*, 2008) with associated huge health advantages (Liyanage, 2017). Honey is produced by honeybees as “blossom honey” by secreting nectars of flowers, and “honeydew honey” (forest honey) by secreting the exudates of plant sucking nectars insects (Aphids). The constituent of honey is mainly sugars and water. In addition, it also contains several vitamins and minerals, including B vitamins. The other compositions of honey are amino acids, antibiotic-rich inhibine, proteins, phenol antioxidants and micronutrients (Huong, 2019) with the most abundant sugar in honey being fructose. Honey is a complete meal as it contains major components of a meal, and micronutrients that will enhance the digestion and absorption of these major components of a meal and micronutrients that will enhance the digestion and absorption of these major dietary components as well as those required for metabolism and body functions. Medicinally, it has been proven to be a promising anti-tumor agent with pronounced anti-inflammatory antiangiogenic effect (Hanaa and Shynaa, 2011), antibacterial, antimetastatic, immune-stimulant, antiulcer and wound/burn healing (Fiorani *et al.*, 2006).

The largest portion of the dry matter in honey consists of the sugars. This very concentrated solution of several sugars results in the characteristic physical properties of honey – high viscosity, “stickiness,” high density,

granulation tendencies, tendency to absorb moisture from the air, and immunity from some types of spoilage. The average pH of honey is 3.9 (with a typical range of 3.4 to 6.1). Honey naturally contains small amounts of enzymes that are introduced into honey by the bees during various phases of the honey manufacturing process. The predominant enzymes in honey are diastase (amylase), invertase ( $\alpha$ -glucosidase) and glucose oxidase. Other enzymes such as catalase and acid phosphatase are generally present in lesser amounts (Veronika, 2018). This nutritional composition of honey (phytochemicals, organic acids, vitamins, and enzymes) may serve as sources of dietary antioxidants (Gheldof *et al.*, 2002; Gheldof and Engeseth 2002).

Honey is a natural substance said to have significant different beneficial effects when taken as diet. From previous studies, it has been proven to be a promising antitumor agent with pronounced anti-inflammatory, antiangiogenic effect (Hanaa and Shynaa, 2011), antibacterial, antimetastatic, immune-stimulant, antiulcer and wound/burn healing (Fiorani *et al.*, 2006). Cardiac risk factors, such as obesity, smoking, hypertension, and chronic periodontal disease, are associated with elevated C-reactive protein (CRP) levels and this marker was decreased by antioxidants present in honey. Recent researches have shown that natural honey lowers fasting blood glucose, total cholesterol, Low density lipoprotein (LDL), Very Low density lipoprotein (VLDL), Triglycerides and increases High density lipoprotein (HDL), thus reducing cardiovascular risks (Al-Waili, 2004; Yaghoobi *et al.*, 2008). Honey contains a variety of biologically active compounds such as flavonoids, vitamins, antioxidants as well as hydrogen peroxides ( $H_2O_2$ ) (Mohammadzadeh *et al.*, 2007) and it has been said to enhance blood profile and have been beneficial to individuals suffering from anaemia (Ajibola *et al.*, 2007). In this study examination of the effect of this nutritious substance on some haematological indices and lipid profile was investigated.

## Methodology

### Location and Duration of Study

The research work was carried in the animal house of the Department of Human Physiology,

Ahamadu Bello University, Zaria. It lasted for a period of two (2) weeks.

### Honey sample

Honey was purchased from the Department of Biological Sciences, Faculty of Life Science (Physiology Laboratory), Ahamadu Bello University, Zaria.

### Experimental Animals

Fifteen male mice of weight 20 – 25g were obtained from the Faculty of Veterinary Medicine, Ahamadu Bello University, Zaria and kept in mice cages in the Animal House of the Department of Human Physiology. They were acclimatized for one week and Pelletized growers feed (vital feed) was obtained and used to feed the animals for the experiment with water at room temperature within a 12-h light and dark (Aliyu *et al.*, 2012).

### Experimental Design

The animals were divided into five different groups of three mice each and treated daily for seven days as shown in figure 3:1. Twenty-four hours after the last administration, animals were humanly sacrificed using chloroform (Aliyu *et al.*, 2012). Blood samples were collected, part of the samples was placed in EDTA bottles for haematological analysis and the remaining were centrifuged at 3,000 rpm for 8 minutes to obtain the serum for analyses.

### Procedure

1. Group 1 - Distilled Water (Control)
2. Group 2 - 10% (v/v) Honey  
10% (v/v) Honey  $\equiv$  10ml of honey in 90ml of distilled water
3. Group 3 - 20% (v/v) Honey  
20% (v/v) Honey  $\equiv$  20ml of honey in 80ml of distilled water
4. Group 4 - 50% (v/v) Honey  
50% (v/v) Honey  $\equiv$  50ml of honey in 50ml of distilled water
5. Group 5 - 100% (v/v) Honey  
100% (v/v) Honey  $\equiv$  100ml of honey

The weights of the animals were determined using an automated weighing balance daily for seven (7) days. Honey of different concentration was administered orally, once daily for seven (7)

days to animals in each group according to their body weights (current) using a 1ml cannula at a dose of: 5ml of honey (%v/v) per 1000g (or 1kg) in weight of the animal (Muhammad *et al.*, 2012). For example, mice weighing 22g will receive a dose of 0.11ml of honey (%v/v).

Blood samples were obtained from the heart (at its apex) during the sacrifice using a 2.5ml syringe and placed in EDTA bottles for haematological analysis and the remaining were collected in a plain non-anticoagulated tube. The samples were allowed to clot and centrifuged at 3,000 rpm for 8 minutes to obtain the serum and placed in plain bottles and used for the determination of lipid profile parameters.

### Determination of Haematological Indices and Lipid Profile

Red Blood cell (RBCs) counts, Differential White blood cell count, Packed cell volume (PCV), Haemoglobin (Hb) levels, Mean Cell Volume (MCV), Mean Cell Haemoglobin (MCH), Haematocrit (HCT) or Packed cell volume (PCV), Mean Cell Haemoglobin Concentration (MCHC) were determined using an Auto Analyzer according to manufacturer's protocols. The High-density lipoprotein (HDL), Low density lipoprotein (LDL), Triglyceride and Total Cholesterol values were also obtained using a reliable Auto Analyzer according to manufacturer's protocols (Aliyu, *et al.*, 2012).

### Lipid Profile

**Table 1: Results of lipid profile of mice after administration of Honey**

Groups	Treatment	Total Cholesterol (mg/dL)	Triglyceride (mg/dL)	HDL (mg/dL)	LDL (mg/dL)
1	Distilled water	48.13 <sup>abcd</sup> ± 2.42	95.48 ± 3.29	20.57 ± 0.28	8.46 <sup>abcd</sup> ± 2.53
2	10% v/v	56.85 <sup>a</sup> ± 2.33	82.03 ± 8.48	21.29 ± 2.34	19.15 <sup>a</sup> ± 2.23
3	20% v/v	56.01 <sup>b</sup> ± 1.43	79.11 ± 10.25	20.20 ± 2.93	19.99 <sup>b</sup> ± 0.59
4	50% v/v	59.90 <sup>c</sup> ± 3.40	68.99 ± 6.18	23.10 ± 3.17	23.0 <sup>c</sup> ± 0.98
5	100% v/v	65.91 <sup>d</sup> ± 2.80	87.04 ± 8.59	32.3 ± 5.91	16.22 <sup>d</sup> ± 4.91

HDL: High Density Lipoprotein, LDL: Low Density Lipoprotein. Values are mean ± SD, n = 3. Values with different superscript along a column are statistically significant (p < 0.05). For Total Cholesterol: [Group 1 is lower than 2, 3, 4, and 5, while Group 5 is higher than 1, 2, 3, and 4]. For LDL: [Group 1 is lower than 2, 3, 4, and 5, while Group 4 is higher than 1, 2, 3, and 5].

### Statistical Analysis

The results were expressed as mean ± standard error of the mean and also graphically using bar charts. Differences between the groups were analyzed by one-way analysis of variance (ANOVA) with the aid of Statistical Package for Social Sciences (SPSS) software, SPSS Inc., Standard version 10.0.1. A p-value < 0.05 were considered statistically significant for all statistical analysis.

### Results

Low density lipoprotein (LDL) and Total cholesterol levels in mice treated with 10% (v/v), 20% (v/v), 50% (v/v) and 100% (v/v) (p < 0.05) as compared to the control group. However, HDL levels in mice treated with 10% v/v, 50% v/v and 100% v/v were higher (p > 0.05) but 20% (v/v) was slightly lower as compared to the control group. Group 5 [100% (v/v)] was higher as compared to group 2 (10% v/v) and 4 [50% (v/v)]. Triglyceride levels showed decrease (p > 0.05) in the rest of the group as compared to the control group. Group 4 was the lowest as compared to group 2, 3 and 5, and Group 5 the highest as compared to 2, 3, and 4. There was increase (p > 0.05) MID (monocyte count) with increasing concentration and increase in Platelet count in Group 2 [10% (v/v)] as compared to the other groups. Hb, PCV and RBCs Count were higher (p > 0.05) in Group 2 [10% (v/v)] as compared to the rest of the groups.



## Haematological Indices

**Table 2: Results of Haematological indices of mice after administration of Honey**

Groups	Treatment	Hb (g/dL)	RBC (mill./ $\mu$ L)	PCV (%)	MCV (fl)	MCH (pg)	MCHC (g/dL)	WBC ( $\times 10^9$ /L)	LYM ( $\times 10^9$ /L)	GRAN. ( $\times 10^9$ /L)	MID ( $\times 10^9$ /L)	PLT ( $\times 10^9$ /L)
1	Distilled Water	14.03 $\pm 1.14$	7.13 $\pm 0.69$	39.43 $\pm 5.20$	56.9 $\pm 0.52$	19.77 $\pm 0.57$	34.7 $\pm 1.13$	8.13 <sup>abcd</sup> $\pm 0.22$	4.73 $\pm 1.10$	0.57 $\pm 0.17$	0.33 $\pm 0.19$	242.67 $\pm 91.53$
2	10% v/v	15.07 $\pm 0.07$	7.67 $\pm 0.54$	44.30 $\pm 2.90$	57.77 $\pm 0.67$	19.70 $\pm 0.71$	34.13 $\pm 0.88$	6.63 <sup>a</sup> $\pm 0.29$	3.93 $\pm 0.52$	0.50 $\pm 0.06$	0.20 $\pm 0.06$	424.67 $\pm 16.18$
3	20% v/v	13.2 $\pm 0.97$	6.66 $\pm 0.44$	38.7 $\pm 3.93$	57.93 $\pm 3.81$	19.77 $\pm 0.23$	34.4 $\pm 1.95$	6.73 <sup>b</sup> $\pm 0.33$	3.97 $\pm 0.69$	0.17 $\pm 0.07$	0.27 $\pm 0.03$	254.33 $\pm 110.63$
4	50% v/v	14.1 $\pm 0.57$	6.57 $\pm 0.94$	37.5 $\pm 4.00$	56.83 $\pm 0.45$	18.5 $\pm 1.42$	32.6 $\pm 2.76$	6.63 <sup>c</sup> $\pm 0.03$	2.43 $\pm 0.47$	0.5 $\pm 0.10$	0.27 $\pm 0.07$	244 $\pm 87.18$
5	100% v/v	12.83 $\pm 0.09$	6.42 $\pm 0.20$	34.2 $\pm 1.95$	55.23 $\pm 1.22$	20.0 $\pm 0.49$	36.3 $\pm 1.19$	5.67 <sup>d</sup> $\pm 0.32$	4.0 $\pm 1.36$	0.5 $\pm 0.21$	0.40 $\pm 0.15$	149 $\pm 30.19$

Hb: Haemoglobin, RBC: Red Blood Cell, PCV: Packed Cell Volume, MCV: Mean Cell Volume, MCH: Mean Cell Hemoglobin, MCHC: Mean Cell Haemoglobin Concentration, WBC: White Blood Cell, LYM: Lymphocyte, GRAN: Granulocytes, MID: Monocytes, PLT: Platelets. Values are mean  $\pm$  SD, n = 3. Values with different superscript along a column are statistically significant ( $p < 0.05$ ), Group 1 is higher than the 2, 3, 4, and 5, while Group 5 is lower than 1, 2, 3 and 4.

### Discussion

The primarily component of honey are sugars such as monosaccharides, disaccharides, oligosaccharides and polysaccharides (Anand *et al.*, 2017; Bogdanov *et al.*, 2008). The common uses of honey are in cooking, baking, as a spread on bread, and as an addition to various beverages, such as tea, and as a sweetener in some commercial beverages. It contains enzymes such as glucose oxidase, diastase, invertase, catalase and peroxidase (Bogdanov *et al.*, 2008). Being rich in carbohydrates like glucose and fructose when ingested could be metabolized to generate energy and help in tissue repair. This study reports the effect of honey on haematological indices and lipid profile at various concentrations using mice.

A decrease in Triglyceride levels and an increase in HDL levels is in concordance with a study which stated that honey intake have the ability to modulate some of the cardiovascular risk factors (Al-Waili, 2004; Swanson *et al.*, 1992) because antioxidants in honey, in addition to their role in lowering blood cholesterol and low density

lipoprotein levels, are also advantageous by inhibiting the formation of atherogenic plaques. Inhibition of atherogenic plaque formation is also determined by a variety of trace elements, minerals, vitamins, contained in honey. Some trace elements that prevent the formation of atherogenic plaques are copper and zinc. Meanwhile, some of the vitamins contained in honey that play a role in preventing oxidative stress and atherosclerotic plaque formation are vitamin E (niacin), vitamin C, vitamin B, and vitamin A). However, an increase in total cholesterol and Low-density lipoprotein were indicators of cardiovascular risks (Yaghoobi, 2008). Potent anti-oxidant, anti-inflammatory and anti-cancerous activities of honey have been reported (Shahid *et al.*, 2018).

An increase in Haemoglobin (Hb) levels, Packed Cell Volume (PVC) and Red blood cell count (RBCs) in mice treated with honey 10% (v/v) shows that honey as an anti-anaemic property. Our finding is consistent with a previous report (Fiorani *et al.*, 2006). This can also be said about an increase in mean corpuscular hemoglobin in

group 5 [100% (v/v)]. An increase in monocyte count (MID) in Group 5 [100% (v/v)] and Platelet count (PLT) in Group 2 [10% (v/v)] shows that honey is an immune-stimulant agent. Our finding is consistent with a previous report (Fiorani et al., 2006).

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