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Effect of honey intake on serum cholesterol, triglycerides and lipoprotein levels in albino rats and potential benefits on risks of coronary heart disease

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Summary: The beneficial effect of honey has been widely reported particularly in the treatment of wounds and gastrointestinal tract disorders. However there is paucity of reports on its effect on the plasma high density lipoproteins (HDL), very low density lipoproteins (VLDL), low density lipoproteins (LDL) and triglycerides (TG) including cholesterol levels despite common consumption of honey worldwide including, Nigeria. The effect of the widely consumed unrefined Nigeria honey on plasma HDL, VLDL, LDL, TG, cholesterol and cardiovascular risk predictive index (CVPI) was studied using 20 adult male albino rats to ascertain its scientific and clinical relevance. The rats were randomly assigned into 2 groups, the control and honey-fed (test) groups, ten in each group. The rats weighed between 190-200gm at the start of the study. The control group was fed on normal rat (Pfizer-Nigeria) while the test group was fed on normal rat feed and honey (1ml of honey was added to 10ml of drinking water given once every day) for 22 weeks. At the end of the experiment, the rats were anesthetized with thiopentone sodium and blood collected by cardiac puncture. Serum TG, HDL, VLDL, LDL and total cholesterol in the control and the test groups were determined. The results showed significant increase in the level of plasma TG, HDL, and VLDL in the test group when compared with the control group ($P<0.01$). In contrast, there were significant decreases in the levels of plasma LDL and total cholesterol in the test when compared with the control group ($P<0.01$). Computed values of CVPI showed significant increase in the test values compared to that of the control ($P<0.01$). It is concluded that consumption of unrefined Nigeria honey significantly improved lipid profile and computed cardiovascular disease predictive index in male albino rats.

Keywords*:* Cardiovascular disease, Honey, Cholesterol, Lipoproteins, Triglyceride

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INTRODUCTION

Honey is a viscous liquid produced by bees from the nectars of various plant products. It occupied prominent place in traditional medicine over 4000 years ago (Postmes *et al.*, 1993). It is widely consumed all over the world today including Nigeria. It was listed in the first medical handbook two thousand years ago as a remedy to be used in burns, cuts and abscesses (Lan, 1976). Honey was used by Russian soldiers in World War I to accelerate wound healing (Bergman *et al.*, 1983). Various efforts made to establish quality values of honey have not been rewarding as the therapeutic effects and potentials of honey have been neglected in modern medicine due to lack of systematic scientific studies. However, scientific supports for its therapeutic effects in many clinical and experimental trials are beginning to emerge as its effectiveness has been reported particularly where conventional treatment has failed (Molan, 1998). Honey is reported to be effective in the treatment of gastrointestinal track disorders in humans (Haffejee and Moosa, 1985; Khan *et al.*, 2007) and in the healing of wounds, burns and ocular disease as well as being an antimicrobial agent (Emerah, 1982; Efem, 1988; Molan, 1992; Molan, 1992; Rudzka-Nowak *et al.*, 2010; Song and Salcido, 2011; Al-Waili *et al.*, 2011). It has also been reported also to have gastric protection effect against acute and chronic gastric lesions in animals (Mobarok and Al-Swayeh, 2003). Honey is composed of simple sugars, amino acid, enzymes, electrolytes,

vitamins, antioxidants, trace elements and minerals with pH between 3 and 4. Modes of administration include oral, topical, and parenteral route. While the beneficial effects of honey have been widely reported (Postmes *et al.,* 1993; Postmes *et al.,* 1997) reports on its effect on lipid profile both in clinical and experimental trials are lacking. This study is therefore aimed at examining the serum levels of triglycerides, HDL, VLDL, LDL and cholesterol in albino rats following the intake of honey for 22weeks and their implications in cardiovascular.

MATERIALS AND METHODS

20 adult male albino rats were used in this study. They were randomly assigned into groups, the control and the honey-fed (test) groups. They weighed between 190-200gm at the beginning of the study. The control group was fed on normal rat feed (Pfizer-Nigeria) with water while the test group was fed on normal rat feed plus honey added to drinking water (1ml of honey to 10ml of water given once every day) for the 22 weeks the study lasted.

After 22 weeks, the rats were weighed, anaesthetized by intraperitoneal administration of sodium thiopentone (6mg/100g body weight) and blood samples collected by cardiac puncture using 5ml syringe. The blood was allowed to clot and serum collected after centrifugation. Serum cholesterol and triglyceride were determined by enzymatic colorimetric methods using kits produced by Human Diagnostic-Germany (Schettler and Nussel, 1975; Trinder, 1981; Trinder and Webster 1984). High density lipoprotein was analyzed using Randox HDL kit, first by precipitating LDL, VLDL and chylomicrons by the addition of phosphotungstic acid in the presence of magnesium ion followed by enzymatic determination of cholesterol in the supernatant fraction obtained after centrifugation (Friedewald, *et al.,* 1972; Lopes-Virella *et al.,* 1977). The serum VLDL and LDL were calculated using Friedewald formula. Also cardiovascular disease risk factor was assessed using method of Ahaneku *et al.,* (1999).

Statistical Analysis

The mean values of HDL, VLDL, CVPI, cholesterol and LDL in the two groups were calculated and compared using Student T-test. P values less than 0.05 were taken as significant.

RESULTS

Figures 1, 2,3,4,5 and 6 represent the mean values of HDL, TG, VLDL, CVPI, plasma cholesterol, and LDL in the test and control groups.

The HDL was significantly higher in honey fed albino rats (1.33±0.04mmol/L) compared to controls (0.57± 0.02mmol/L) ($p<0.01$) as shown in figure 1

Triglyceride was significantly higher in honey fed albino rats (0.84±0.02mmol/L) compared to controls(0.25±0.03mmol/l) ($p<0.01$) as shown in figure 2. Very low density cholesterol was significantly higher in honey fed albino rats (0.72±0.03mmol/L) compared to controls (0.12± 0.01mmol/l) ($p<0.01$) as shown in figure 3. Cardiovascular risk predictive index was significantly higher in honey fed albino rats (0.61±0.04) compared to controls (0.17± 0.01) ($p<0.01$) as shown in figure 4

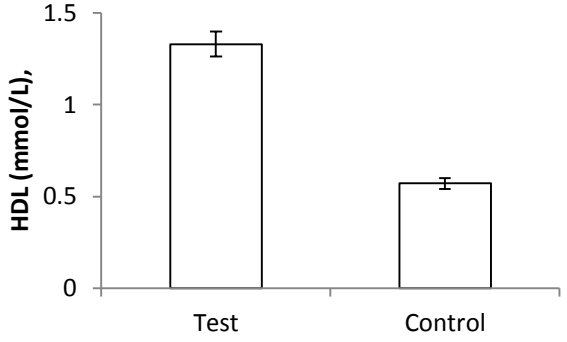

Fig 1:
Serum HDL levels of test and control groups. **=P<0.01 when compared with control

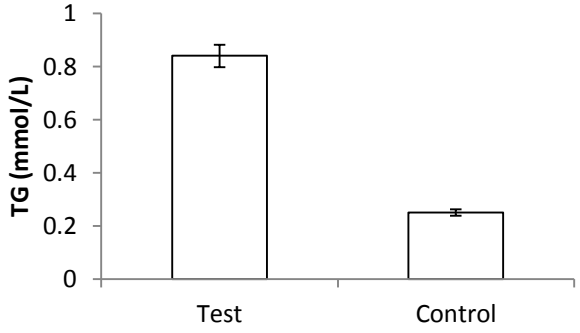

Fig 2:
Serum triglyceride levels of test and control groups. **=P<0.01 when compared with control

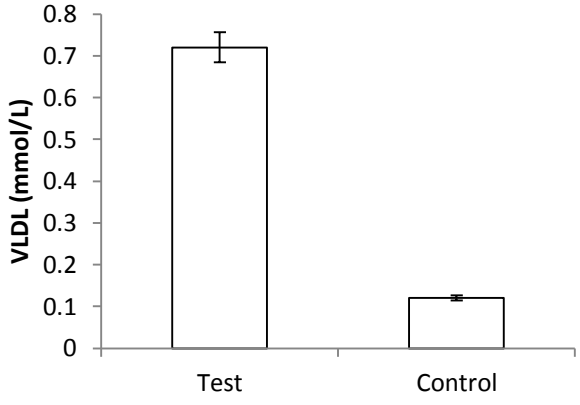

Fig 3:
Serum VLDL levels of test and control groups. **=P<0.01 when compared with control

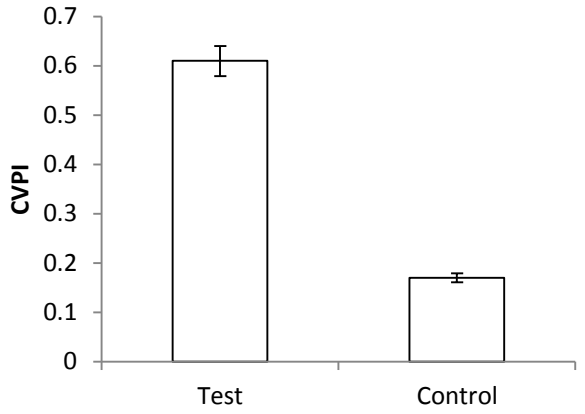

Fig 4:
Cardiovascular risk predictive index of test and control groups. **=P<0.01 when compared with control

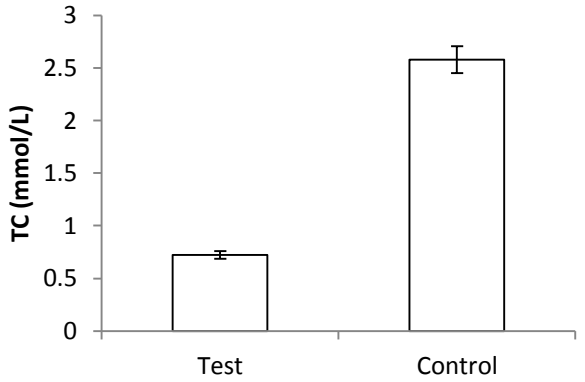

Fig 5:
Serum total cholesterol levels of test and control groups. **=P<0.01 when compared with control

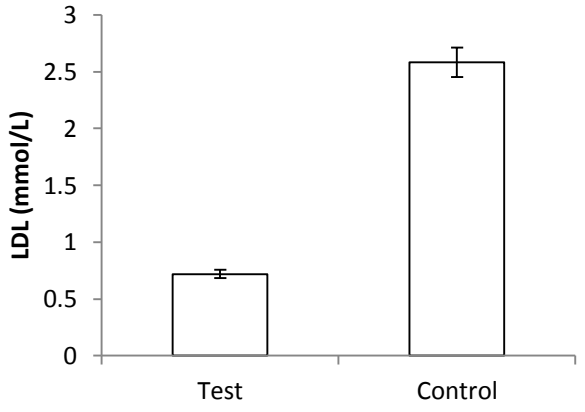

Fig 6:
Serum LDL levels of test and control groups. **=P<0.01 when compared with control

Total cholesterol was significantly lower in honey fed albino rats (2.19± 0.03mmol/L) compared to controls (3.35± 0.04mmol/L) ($p<0.01$) as shown in figure 5 Low density cholesterol was significantly lower in honey fed albino rats (0.72±0.03mmol/L) compared to controls (2.58± 0.02mmol/L) ($p<0.01$) as shown in figure 6

DISCUSSION

Hypercholesterolemia is a common feature in atherosclerosis, the complications of which lead to ischaemic heart disease, myocardial infarction and stroke. It reflects changes in lipoprotein concentrations of plasma. High cholesterol content of plasma is believed to be the main cause of atheromatous lesions of blood vessels. Attempts have been made to develop drugs which reduce the concentration of plasma cholesterol because of its role in the etiology and course of atherosclerosis which include statin groups of drugs and the vitamin niacin (Schild, 1980; Kolovou *et al*., 2008; Perry, 2009; Sanyal *et al.*, 2010). This work was carried out to evaluate the effect of the intake of unrefined Nigerian honey on serum HDL, VLDL, LDL TG and total cholesterol levels using albino rats. High density lipoprotein, VLDL and LDL are endogenous transport systems in the blood that transport triglycerides and cholesterol throughout the body. Cardiovascular disease predictive index determines degree of risk factor/ magnitude of cardiovascular disease. Very low density lipoprotein are formed in the liver and transport triglycerides formed from fatty acids and carbohydrates in the liver to extra hepatic tissues. While LDL transports cholesterol to the peripheral tissues including macrophages, HDL transport cholesterol from the intestine and peripheral tissues to the liver for excretion, and by so doing, lowers the plasma cholesterol level. The result of this study showed significant increases in plasma HDL, VLDL, TG, and computed CVPI in honey-fed rats compared with the control group ($p<0.01$) and significant decreases in plasma LDL and cholesterol levels in the test group compared with the control group ($p<0.01$)

The Mechanisms whereby honey increases plasma HDL, VLDL and triglycerides and decreases LDL and cholesterol as observed from this study are not clear. Alagwu, (2008) however speculated that honey increases bile cholesterol excretion and lowers plasma cholesterol. Plasma lipoproteins (HDL, VLDL and LDL) are spherical macromolecular complexes of lipids and proteins. The lipid constituents comprise of esterified and unesterified (free) cholesterol, triglycerides, and phospholipids. The protein components are termed apolipoproteins. Lipoproteins transport cholesterol and triglycerides (which are not water soluble) from sites of absorption and synthesis to sites of utilization. While HDL and VLDL produced by the liver, transport triglycerides and cholesterol from the peripheral tissue to the liver for metabolism and excretion, LDL transports

cholesterol from the blood to the peripheral tissues including arteries (Ganong, 2003). The association between an increase in LDL and atherosclerosis as well as the anti-atherogenic nature of HDL had long been recognized. It has been reported that niacin vitamin lowers plasma cholesterol. It has been widely used as a pharmacologic agent to regulate abnormalities in plasma lipid and lipoprotein metabolism and in the treatment of atherosclerotic cardiovascular disease. The molecular mechanism of action of niacin on lipid and lipoprotein metabolism appears to be on its ability to reduce triglycerides and apolipoprotein-B containing lipoproteins (e.g., VLDL and LDL) through decreasing fatty acid mobilization from adipose tissue triglyceride stores, and inhibiting hepatocyte diacylglycerol acyltransferase and triglyceride synthesis leading to increased intracellular apo B degradation and subsequent decreased secretion of VLDL and LDL particles. The mechanism to raise HDL is by decreasing the fractional catabolic rate of HDL-apo AI without affecting the synthetic rates (Ganji *et al*., 2003; Kamanna and Kashyap 2008; Kamanna *et al*., 2009). The vitamin niacin and large doses of antioxidants (vitamin E) slow the progress of atherosclerosis in experimental animals (Sasani *et al*., 2011). Although phytochemical analysis of honey does not show the composition of niacin, it comprise of substances which may exhibit niacin-like properties. These substances which include norisoprenoids, benzene derivatives, aliphatic compounds, maillard reaction products (Jerkovic *et al*., 2010) could have beneficial effects on cardiovascular functions. Also the phenolic composition and antioxidant properties of hive product collected by honey bees (Dudonne *et al*., 2011) are cardiovascular protective, especially flavonoids which play important role in vitamin E regeneration. It is therefore possible that honey reduces plasma cholesterol by its antioxidant properties and by enhanced HDL synthesis by liver. Increase in CVPI observed in this study showed that honey may be beneficial in reducing incidence of cardiovascular diseases.

It is therefore concluded that honey intake decreased plasma cholesterol and LDL, increased HDL, VLDL and triglycerides in albino rats. The overall effect of honey administration on lipid and lipoprotein indices of experimental albino rats generally suggested a potential reduction in the risk of coronary heart disease as evidenced from the beneficial coronary heart disease risk predictive index calculated in favor of the honey fed albino rats. The anti-atherogenic property of honey should be explored further and the beneficial effects on human subjects are hereby anticipated and should be evaluated.

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