ORIGINAL ARTICLE

EFFECTS OF NATURAL HONEY ON BLOOD GLUCOSE AND LIPID PROFILE IN YOUNG HEALTHY PAKISTANI MALES

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Background: Honey has been shown to have beneficial effects on the glucose and lipid profiles in patients at high risk of heart diseases. Therefore, this study was carried out to investigate the effects of natural honey on blood glucose and lipid profile in healthy individuals. **Methods:** A randomized controlled trial was carried out in the Army Medical College, Rawalpindi, Pakistan, spanning 4 weeks, that is, from 15th Feb–15th March 2009**.** A total of 70 healthy young boarders of the same college were included in the study and randomly divided into two groups of 35 each using random number table. Seventy gram (70g) of honey was given to each individual in the experimental group daily for a period of 4 weeks while control group was kept on the same diet as that of experimental group except honey. The fasting glucose, total cholesterol, low density lipoprotein (LDL), high density lipoprotein (HDL) and triglyceride (TG) levels were measured before and after the experiment. **Results:** The fasting glucose levels in both groups were raised. However, the increase in the experimental group was significantly less than that in the control group ($p<0.05$). The levels of total cholesterol, LDL and triglycerides in the control group increased while those in the experiment group decreased significantly ($p<0.05$), while HDL levels were decreased in the former and increased in the latter group ($p<0.05$). **Conclusion:** Natural honey consumption significantly limits the rise in blood glucose along with a significant decrease in the levels of total cholesterol, LDL and triglycerides, and increase HDL in young healthy adults.

Keywords: Honey, Glucose profile, Lipid profile

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INTRODUCTION

From ancient times, honey is known to be one of the most beneficial drugs of nature. Through the ages people have found many uses of it. It was used as an alternative to gold by the Romans, in matrimonial ceremonies by the Greeks, and in the treatment of wounds by the Egyptians.[1,2] Honey has got dynamic and multidimensional medicinal and surgical uses. In a research it is established that honey improves insulin sensitivity.[3] Significant increase in the insulin secretion capacity is associated with decrease in circulating leptin, total cholesterol, and LDL.[4] 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.[5,6] In an experiment on dogs, it has been noted that fructose is having a unique ability to increase uptake of hepatic glucose and insulin that is suggestive of its modulating property of glycaemic control.[7] Fructose being a major component of honey improves the glycaemic response to a glucose load.[8,9] The harmful and genotoxic effects of mycotoxins are reduced and the gut micro flora is improved by honey.[10] Honey is helpful in the treatment of psoriasis[11], diaper dermatitis[12], pityriasis versicolor, tinea cruris, tinea corporis and tinea faciei.[13] Honey is very effective in healing of wounds.[14] Honey increases the production against thymus-dependent and thymus-independent antigens in primary and secondary immune responses.[15] Natural honey lowers plasma prostaglandin concentrations.[16] Honey improves haematological indices.[17] Recent researches by Al-Waili and L. Chepulis have shown that natural honey lowers fasting blood glucose, total cholesterol, LDL, VLDL, TG's and increases HDL, thus reducing cardiovascular risks.[5,6] Since honey shows these effects by multiple proposed mechanisms which might be influenced by the genotypes, geographical distribution of the subjects and the type of honey used, so the effects of honey collected from Pakistan were seen on Pakistani Subjects in our study. Age, gender, diet (except honey) and life style of the subjects which may confound the results were kept constant in our study. The objective of this study was to investigate the effects of natural honey collected from Pakistan on blood glucose and lipid profile in healthy Pakistani individuals keeping strict control conditions including same sex, place of living, life style , diet (except honey) and more or less same age of the subjects.

MATERIAL AND METHODS

These randomized controlled trials were carried out in Army Medical College, Rawalpindi, Pakistan from 15th February to 15th March 2009. Before the start of study, Research Advisory Committee approved the

research and informed written consent was taken from all subjects. The subjects of this research were newly admitted first year students of Army Medical College, Rawalpindi, Pakistan and their complete physical and clinical examination and laboratory investigations were done which is mandatory for admission to the college. Their results showed that all had normal complete blood and cardiac function. The subjects were in the same hostel on the same diets and the same daily routine. Seventy subjects were included in the study through convenient sampling and randomly divided into two groups of 35 each using random number table. Seventy grams (70 g) of honey was given daily for a period of four weeks to each individual in the experimental group dissolved in 250 ml of tap water and then ingested while control group was kept on the same diet as that of experimental group except honey. The honey was purchased from Ilyas Traders, Charsadda, Khyber Pakhtunkhwa, Pakistan. The honeybees (Apis mellifera) fed on trees of Acacia modesta. The honey was natural, unprocessed. Three subjects from experimental group and four subjects from control group dropped out because their daily routine and diet changed significantly during the course of study and some of them started taking medicines which could affect the results of our study. The fasting glucose, total cholesterol, LDL, HDL, TG levels were studied at the start of the study and then after 4 weeks. Laboratory investigations were performed using spectra 2 auto-analyzer, by Merck Company, Germany.

The results had been analyzed using SPSS-15. Quantitative variables were described as mean±standard deviation (SD). Paired sample's *t*-test was applied to compare initial and final levels of study variables within each group. Change in study variables were compared between the groups through independent sample's *t*-test. A *p*-value of ≤0.05 was taken as significant.

RESULTS

Average age of the boys of experimental group was 20.13±0.14 years and of control group was 20±0.15 years. Both the groups were comparable with respect to age (p=0.537), fasting blood glucose (p=0.083), total cholesterol (p=0.060), TG (p=0.195), LDL (p=0.137) and HDL level (p=0.142).

In experimental group, significant decrease was observed in total cholesterol (p<0.001) and LDL level (p=0.001) while HDL level was increased significantly (p=0.005) while change in glucose and triglyceride were not significant. In control group, significant increase was observed in glucose (p<0.001), total cholesterol (p<0.001), triglyceride (p=0.009) and LDL (p=0.002) while insignificant decrease was observed in HDL level (p=0.433). (Table-1)

The changes in all the variables within four weeks between both the groups were compared. Increase in serum fasting glucose level in experimental group was significantly lower than that of control group (p=0.011). Total cholesterol was decreased in experimental group while it was increased in the control group and this change was significantly different between both the groups (p<0.001). The TG level was reduced in experimental group where as it increased in control group and this difference in change was significant (p=0.018). In LDL level decrease in experimental group and an increase in control group was observed and the change between both the groups was significantly different (p<0.001). The HDL level was increased in experimental and decreased in control group. Change in HDL level in experimental group was significantly different as compared to that in control group (p=0.013). (Table-2)

Table-1: Within the group comparison of initial and final levels

Variables (mmol/L)	Control (n=31)		Cases (n=32)	
	Initial	Final	Initial	Final
Glucose	4.88±0.06	5.27±0.06*	5.03±0.06	5.16±0.08 [NS]
Total cholesterol	3.54±0.10	3.83±0.13*	3.89±0.15	3.49±0.11*
TG	0.70±0.04	0.84±0.04*	0.82±0.09	0.76±0.05 [NS]
LDL	2.58±0.08	2.81±0.11*	2.78±0.10	2.49±0.08*
HDL	0.722±0.02	0.706±0.02 [NS]	0.779±0.03	0.823±0.03*

Data was expressed as mean±SE
* Final level is significantly different from initial level
[NS] Final level is insignificantly different from initial level

Table-2: Comparison of change between groups

Variables (mmol/L)	Control (n=31)	Cases (n=32)	*p*-value
Glucose	0.390±0.074	0.122±0.071	0.011*
Total cholesterol	0.287±0.052	0.403±0.092	<0.001*
TG	0.139±0.050	0.062±0.060	0.018*
LDL	0.228±0.066	0.288±0.075	<0.001*
HDL	-0.016±0.020	0.044±0.014	0.013*

Data was expressed as mean±SE
*Levels are significantly different between both the groups

DISCUSSION

In the present study we measured serum levels of glucose, triglycerides, total cholesterol, LDL and HDL. The levels of these substances are regulated within an optimum range by body homoeostatic mechanisms. But their levels are subject to change by various internal and external environmental factors. One of the significant factors is the dietary changes that the modern lifestyle has brought along with it in the form of fast foods. The changes in the levels of these substances make the human body prone to various clinical disorders. Glucose is a monosaccharide, the immediate source of energy for human body and its level is increased in Diabetes

Mellitus. In the past cholesterol had been portrayed by some a poison but it has dichotomy of good (HDL) and bad (LDL) and is essential for the synthesis of bile acid and some of steroid hormones.[18] Triglycerides are major component of VLDL and plays key role in metabolism as energy source and in fat transport but its role in cardiac risk factor is also reported.[5,6] LDL is also involved in transportation of cholesterol to different body tissues where only small amount is used and rest of other is free.[19] Thus, LDL plays a part in the development of cardiac complications. Elevated level of native LDL is not associated with cardiac risk rather oxidized LDL is involved in the formation of atherosclerotic plaque.[20] HDL is a good cholesterol, reservoir of apolipo-proteins, take up the unesterified cholesterol both from other lipoprotein particles and from cell membranes and then esterify it and takes it to liver, thus helping in reverse cholesterol transport.[19] Elevated levels of HDL decreases cardiovascular risk factors.[5] In our study, the effects of honey on the plasma levels of these various bio-molecules have been recorded. Glucose levels in both groups were raised. However, increase in the fasting glucose levels of the experimental group was significantly less than those in the control group. Levels of total cholesterol, LDL and triglycerides in the control group increased while those in the experiment group decreased significantly. HDL level was increased in experimental group where as it decreased slightly in control group and this difference was significant. This substantiates the work done by other researchers.[5,6,21] Honey alters the plasma levels of these substances by various biochemical mechanisms. Honey has been shown to decrease blood glucose level. Honey has got stimulatory effect on the secretion of insulin and also improves insulin sensitivity[3], thereby reducing glucose level. Honey produces hydrogen peroxide which has insulin like effects.[21] Honey has nitric oxide (NO) metabolites and probably stimulates NO synthase and so increases NO production.[22] Nitric oxide is stimulatory to the release of insulin.[23] It has been found that honey decreases the plasma and urinary levels of some prostaglandins like PGE2, PGF2 and TXB2.[16,22] Prostaglandins are inhibitory to insulin secretion.[24] Zinc and Copper are normal constituents of honey. So administration of honey increases serum zinc and copper levels which play significant role in the metabolism of insulin and glucose.[17,25] Fructose in the honey may decrease the hyper glycaemic response of glucose content of honey.[5] It has been found that low dose fructose administered with glucose decreased the glycaemic response to a glucose load in healthy individuals and type 2 diabetic patients.[8,9] It was proposed that fructose acted possibly by stimulating glucokinase translocation.[9] So honey might stimulate glucokinase to take up the glucose into the liver.[5] Honey decreased TGs, total cholesterol and LDL. As discussed earlier honey stimulates insulin release. Insulin is stimulatory to lipoprotein lipase which cause breakdown of triglycerides present in plasma lipoproteins to free fatty acids and glycerol, which are transported to peculiar sites and get metabolized.[19] Administration of large amounts of fructose increases TGs, total cholesterol and LDL.[26–28] Administration of low dose fructose along with glucose causes the opposite effect; they decreased TG, total cholesterol and LDL.[27,28] The same effect has been achieved with honey. It has also been found that fructose in smaller concentrations decrease hepatic cholesterol synthesis by decreasing the activity of hepatic 3-hydroxy-3-methylglutaryl-coenzyme A (HMG-CoA) reductase.[29] Niacin is a normal constituent of honey although present in lesser amount. Lipolysis in adipose tissue results primarily in increase level of circulating free fatty acids in blood which are taken up by liver and used in TGs synthesis.[19] Niacin strongly inhibits this lipolysis in adipose tissue which results in decrease in hepatic TGs synthesis and thus TGs plasma levels.[19] TGs synthesis is required for VLDL synthesis and LDL is derived from VLDL in blood plasma.[19] So Niacin decreases plasma TGs, total cholesterol and LDL. Honey might mediate a part of its lowering effect on TGs, total cholesterol and LDL through niacin. As mentioned earlier oxidized LDL is responsible for atherosclerotic plaque formation. Honey decreases oxidized LDL due to presence of anti-oxidants in honey like ascorbic acid, pyridoxine, pantothenic acid, riboflavin and Thiamine. In the present research increase in HDL in experimental group is significant as compared to the decrease in control group**.** As discussed earlier, HDL gets cholesterol from cell membranes and other lipoproteins like LDL and transports it to the liver. We have also seen that honey decreases LDL levels. So, less HDL is used up in transporting cholesterol from LDL to liver because of decreased LDL. Like this less LDL is used up in its physiologic process, so HDL levels rises. So honey increase HDL levels indirectly by decreasing LDL, this needs further experimentation. Foods with high glycaemic index have been associated with decreased HDL levels.[30] So Honey being a low glycaemic index food increases HDL.[5] Increase in HDL levels has been associated with weight loss and nicotinic acid.[31] Honey reduces weight and so increases HDL levels.[5] Nicotinic acid (niacin) present in honey although in lesser amounts might increases HDL levels.

CONCLUSION

Consumption of honey for a period of 4 weeks is effective in reducing glucose, TG's, total cholesterol, LDL and increasing HDL in young healthy adults. Therefore, healthy individuals should include honey in their diet to improve their glucose and lipid profile, and to prevent acquiring diseases in which the levels of

glucose, TGs, total cholesterol and LDL is increased and HDL is decreased like diabetes, cardiovascular diseases, hyperlipidemias, and obesity.

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