EFFECT OF MUFA ENRICHED EXTRA VIRGIN OLIVE OIL ON GLYCEMIC STATUS AND INSULIN SECRETION IN DIABETIC RATS

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ABSTRACT

Objective: To evaluate the effect of monounsaturated fatty acid enriched extra virgin olive oil on glycemic status and insulin secretion in diabetic rats.

Study Design: Randomized Control Trial.

Place and Duration of Study: Department of Biochemistry, Army Medical College, Rawalpindi in collaboration with Centre for Research in Experimental and Applied Medicine, Army Medical College, Rawalpindi and National Institute of Health, Islamabad from March 2010 to June 2011.

Material and Methods: Eighty albino rats of Sprague-dawley strain weighing 200-250 g were randomly divided into two groups of 40 rats each. Rats were made diabetic by injecting streptozotocin. Group 1 and Group II were given normal rodent diet and extra virgin olive oil supplemented diet respectively for 06 weeks. At the end of experimentation, fasting blood glucose, glycosylated hemoglobin and insulin were measured.

Results: There was significant decrease of fasting blood glucose & glycosylated hemoglobin and significant increase of serum insulin of group II rats when it was compared with group I (control).

Conclusion: Monounsaturated fatty acids enriched extra virgin olive oil can significantly improve glycemic status and serum insulin in diabetic rats.

Keywords: Diabetes mellitus, Hyperglycemia, glycosylated hemoglobin, Insulin, Extra virgin olive oil, Sprague-dawley rats.

INTRODUCTION

Diabetes Mellitus (DM) is a growing and ponderous silent epidemic, which has the potential to cripple health services all around the world. Currently, there are 285 million adults diabetics worldwide and this number is anticipated to increase to 300 million adults by year 2025[1,2]. While much of this increase is expected to occur in developing countries, the reasons of which are not country-specific, rather the consequences of population aging, increasing urbanization, unhealthy diets, obesity and sedentary lifestyle. Globally, diabetes is ranked as the fifth leading cause of death[3]. Even in Pakistan almost 10% of the adult population suffers from DM[4]. Diabetic population in rural Sind is 13.9% followed by urban Punjab where it is 13.68%. In rural NWFP, it is 12%, while in urban Baluchistan it is 10.8% (5, 6). It is expected that in the year 2025 the diabetic population in Pakistan will increase to 14.5 million and then Pakistan will be 4th on the list of top ten[5].

Recent research has suggested a multipronged strategy for the treatment of DM. Apart from medicines, diet and lifestyle are considered to be key affecting factors for diabetes management. According to American Diabetes Association (ADA); Medical nutrition therapy (MNT) is playing a vital role in management of existing diabetes, prevention or at least slowing down the rate of development of its complications[7]. The principle aim of MNT is to decrease the glucose load to the body and to increase the production and effectiveness of insulin. Previously, nutritional recommendations for diabetic patients were mainly focused toward carbohydrate (CHO) rich diets, in order to avoid the increased cardiovascular risk associated with saturated fats rich diet. However, diets rich in CHO may make it difficult to achieve glycemic control. Thus, monounsaturated fatty acids (MUFAs) rich diets are preferably encouraged for diabetic patients because of their beneficial effects on

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glycemic control and cardiovascular parameters in diabetic patients[8].

Extra virgin olive oil (EVOO) is the superior quality of unrefined edible olive oil, extracted by the first pressings of the olive fruit, naturally packed with MUFA and polyphenol antioxidants. Each 100 g of EVOO contains about 73.7 g of MUFA (n-9 oleic acid 18:1)[9,10]. Keeping it in view, we planned our study in diabetic rats, feeding them EVOO supplemented diet for 06 week to evaluate their effect on hyperglycemia and insulin secretion.

MATERIALS AND METHODS

The study was conducted in the Department of Biochemistry and Molecular Biology, Army Medical College, Rawalpindi in collaboration with Centre for Research in Experimental and Applied Medicine (CREAM), Army Medical College and National Institute of Health (NIH), Islamabad from March 2010 to June 2011. The study design was randomized control trial. This study was carried on eighty, 60-90 days old Albino rats of Sprague dawley strain, weighing between 200-250g. Rats were obtained from the animal house of the NIH, Islamabad and were kept at its animal house. Rats were made diabetic by injecting streptozotocin (STZ) 40-mg/kg/body weight intraperitoneally dissolved in citrate buffer. On the third day, their fasting blood glucose was measured by taking blood from tail veins under aseptic measures. Rats with blood glucose level more than 126 mg/dl were considered as diabetic and were used in study. The diabetic rats were randomly divided into two groups of 40 rats each:

GROUP-1(Diabetic Control Group): Forty diabetic rats in group–I served as control animals for the experimental group of study. They were fed standard pelleted diet as per requirement, prepared at NIH, Islamabad, according to the international standards for 06 weeks.

GROUP-2(Diabetic Experimental Group): Forty diabetic rats in group–2 fed with EVOO supplemented diet as per requirement, prepared at NIH, Islamabad, for 06 weeks. EVOO supplemented diet is the diet containing 100 grams EVOO per kilogram of pelleted diet.

Rats were kept under standard conditions with a daily photo period of 12 hours light and 12 hours dark at 23 ± 2^{o} C. Five animals were kept in one iron cage. All groups had free access to food and water. At the end of experiment, fasting blood samples were drawn through intracardiac puncture. Blood glucose, glycosylated hemoglobin (HbA1c) and insulin were measured by using commercial kits, in accordance with the instructions of the manufacturers, by applying the glucose/oxidase, enzymatic colorimetric and immunoassay methods respectively.

Statistical Analysis

The data was entered and analyzed using SPSS version 15.0. The arithmetic mean and standard deviation of fasting blood glucose, HbA1c and serum insulin were calculated. The statistical significance of difference across the groups was determined by applying independent sample's t test. The difference was considered significant if *p* value was found less than 0.05.

RESULTS

Results of fasting blood glucose, HbA1c and serum insulin of group I and II rats are mentioned in Table 1. There was significant decrease of fasting blood glucose & HbA1c and significant increase of serum insulin of group II rats when it was compared with group I

Table-1: Comparison of fasting blood glucose, glycosylated hemoglobin and insulin of group 1 and group 2. The values are expressed in mean ± SD.

Parameters	Control Group 1 (n=40)	Extra virgin olive oil Group 2 (n=40)	*p*-value
Blood Fasting	456.52 ± 87.67	365.21 ± 75.64	< 0.05
Glycosylated Haemoglobin (HbA1c) (%)	15.68 ± 4	12.54 ± 3.60	< 0.05
Insulin (ug/l)	0.302 ± 0.092	0.586 ± 0.124	< 0.05

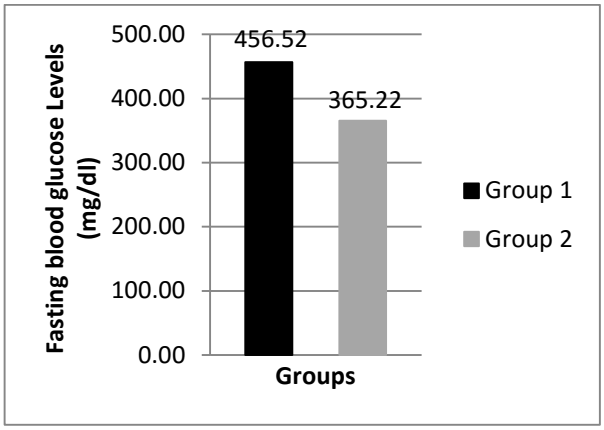

Fig. 1: Comparison of fasting blood glucose level between group 1 and group 2.

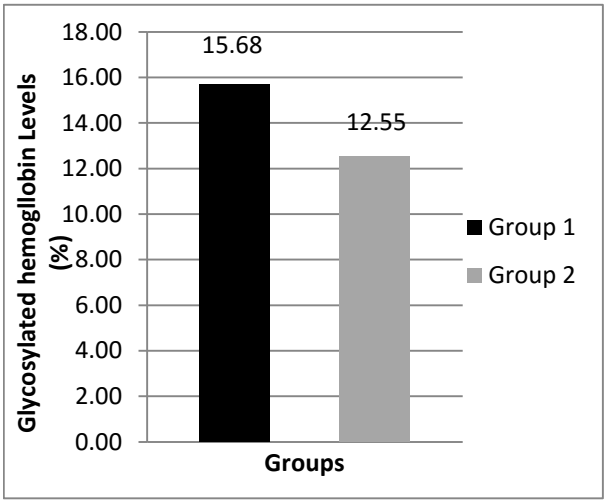

Figure-2: Comparison of glycosylated hemoglobin level between group 1 and group 2.

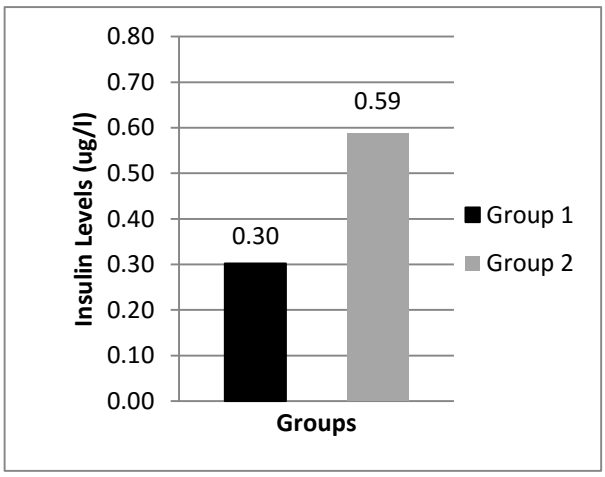

Fig. 3: Comparison of serum insulin level between group 1 and group 2.

(control) (table-1, fig1, fig2 and fig 3).

DISCUSSION

DM is a multisystem disease but the main effects are transmitted through blood. In DM the condition of the body is assessed mainly by measuring glycemic status (fasting plasma glucose & HbA1c), serum insulin level and lipid profile. HbA1c is a reliable index of glycemic control in diabetes. There was significant improvement of fasting blood glucose, HbA1c and serum insulin of group II rats fed with MUFA enriched EVOO.

Ramesh et al. and M. Alhazzaet al. concluded from their experimental studies that MUFA rich groundnut and olive oil significantly improved blood glucose and HbA1c in normal and diabetic rats, which are corresponding to our results[11,12]. Picinato MC et al. found that olive oil increased insulin secretion in isolated pancreatic islet of rats, which correlates to our findings[13]. In conjugation to these findings, Prieto et al. and Paniagua et al. from their experimental studies in human and rats respectively showed that olive oil enhances insulin secretion[14,15]. These findings are also in synchronization with those reported by Assy N et al., who observed that MUFA-rich diet improves postprandial glucose in diabetic patients[9].

Lopez S et al. compared the effects of meals enriched in MUFAs and saturated fatty acids (SFAs) on postprandial lipid, glucose, and insulin concentrations in dyslipidemic patients and concluded that MUFA diet plays an important role in optimal glycemic control[16]. These results are also in synchronization with the research work carried out by Schwingshackl et al. in diabetic patients, who found that high MUFA diets appear to be effective in reducing HbA1c, and therefore, should be recommended in the dietary regimes of diabetic patients[17].

The findings in the present study are in contrast with Cancelaset al experimental studies in type 2 diabetic rats. He gave them olive oil diet for fifty days but not found any improvement of insulin content of the pancreas, glucose tolerance test and there was a paradoxical lowering of the insulinogenic index (18). The findings in the present study are also

partially in contrary with results of research conducted by Yokoyama et al in healthy and diabetic patients[19]. They found that olive oil suppressed hyperglycemia without exaggerating insulin secretion.

CONCLUSION

Present study substantiates the observation that EVOO significantly improves glycemic status and insulin secretion. Hence, it can easily be contemplated that EVOO has antihyperglycemic and insulinotropic effect in diabetics.

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