The study was designed to investigate the levels of l-arginine, l-carnitine, zinc, magnesium and chromium in patients with type 2 diabetes. 100 samples of peoples with type 2 diabetes aged (17-65) years were used, divided into (50 males and 50 females), and the data was compared with 100 healthy subjects (50 males and 50 females) as a control group. Also, biochemical parameters of fasting blood glucose, serum insulin, serum c-peptide and cumulative hemoglobin HbA1c% were measured for both patients and control groups. The results indicate that diabetic patients have lowered levels of l-arginine and l-carnitine (88.03± 4.45, 38.79± 4.18) sequentially, and zinc, magnesium and chromium (0.54± 0.08, 1.58± 0.10, 0.12± 0.02) sequentially in blood compared with the healthy subjects of control group where the levels of l-arginine, l-carnitine, zinc, magnesium and chromium (107.59± 9.75, 56.48± 4.08, 0.90± 0.12, 1.99± 0.20, 0.22 ± 0.04) sequentially. Also, there was elevated levels of fasting blood glucose, serum insulin, serum c-peptide and HbA1c% in diabetic patients (206.85± 33.34, 27.48± 5.78, 4.45± 0.81, 9.09± 1.52) sequentially compared with the control groups (87.04 ± 9.37, 16.48 ± 3.64, 2.66 ± 0.73, 3.83 ± 0.96) sequentially.

**Keywords:** Type 2 diabetes, amino acids, metals.

### 1. Introduction:

Diabetes mellitus (DM) is a chronic, progressive metabolic disease characterized by hyperglycemia, which is largely caused by a lack of absolute (Type 1 DM) or relative (Type 2 DM) insulin hormone action. Because of metabolic irregularities produced by hyperglycemia, diabetes affects nearly every organ in the body, especially if diabetes treatment is ineffective over time. It was assumed to be a disease that exclusively plagued rich countries until recently, but recent data suggest an increase in the number of new cases of type 2 diabetes in developing countries, with an earlier onset and accompanying consequences (1-3).

Type 2 diabetes (also known as Adult-onset diabetes or insulin-independent diabetes mellitus). It is characterized by insulin resistance. Type 2 diabetes is a diverse illness that accounts for 90-95 percent of all diabetes diagnoses. type 2 diabetes develops in people who do not correct for insulin resistance by increasing insulin output in the pancreas. This insulin shortage is caused by pancreatic beta-cell loss and malfunction (4). Diabetes type 2 has multiple causes, including genetic and environmental variables that impact the activity of beta cells and tissues (muscle, liver, adipose tissue, and the pancreas) insulin sensitivity (5). Zinc plays a critical function in the metabolism of glucose by muscle and fat cells. Zinc has been shown to play a role in the insulin receptor-initiated signal transduction process and insulin receptor production (6). Supplementing with magnesium and chromium could be a viable option for preventing type 2 diabetes. Insulin action, insulin-mediated glucose absorption, and vascular tone are all regulated by intracellular Mg. A link between diabetes mellitus and magnesium insufficiency is well documented. The importance of Mg metabolism in modulating insulin action and sensitivity was established (7). Arginine and carnitine concentrations in diabetic animals have been found to be lower in various investigations.
(8- 10) Carnitine infusion improved glucose oxidation and glycogen storage in type 2 diabetes mellitus (T2DM) patients (11, 12).

2. Materials and Methods:

2.1. Study Design:-

This study was conducted at Specialized Center of Endocrinology and Diabetes in Thi-Qar/ Iraq, at the period between 2th September 2021 to 30th December 2021. Diabetic cases chosen from adult patients with type 2 DM that attending this center during the period of the study. The study included drawing blood samples for (200) subjects, (100) patients (50male and 50female) with T2DM aged (18-65) and 100 healthy (50 male and 50 female) as a control group.

2.2. Blood analysis:

A samples of venous blood, about (10ml), was drown from each patients and healthy subjects and put into a sterile plain tube (carrying the name of the subjects in the study), to be used later for measuring the levels of zinc, magnesium, chromium, arginine and carnitine in addition to parameters of fasting blood sugar, serum insulin, serum c-peptide. Furthermore, EDTA tube with anticoagulant was prepared in which about one milliliter of blood was placed and used for HbA1c% measurement.

Serum was prepared by centrifugation of the collected blood samples at 3000 rpm for 15 minutes. By using a disposable sterile pipette, 2 ml of serum was transferred to another sterile plain tube and stored at -20 °C for subsequent measurements.

2.2.1. Measurement of Fasting Blood Glucose:

Fasting serum glucose was measured using an enzymatic colorimetric method (13).

2.2.2. Measurement of Serum Insulin Concentration:

Serum insulin was measured using elecsys insulin kit by cobas e 411/Germany.

2.2.3. Measurement of Serum C-peptide Concentration:

Serum c-peptide was measured using elecsys c-peptide kit by cobas e 411/Germany.

2.2.4. Measurement of HbA1c%:

The percent of glycated hemoglobin is measured using D-10™ hemoglobin testing system.

2.2.5. Measurement of Zinc Concentration:

Zinc was measured using zinc kit by LTA, Italia.

2.2.6. Measurement of Magnesium and Chromium Concentrations:

Magnesium and chromium was determined according to literature (14).

2.2.7. Measurement of L-arginine Concentration:

L-Arginine was measured using L-Arginine kit by Sigma-Aldrich, USA.

2.2.8. Measurement of L-carnitine Concentration:

L-carnitine was measured using l-carnitine kit by Sigma-Aldrich, USA.

3. Statistical Analysis:

The statistical analysis proceeded in all groups of study, descriptive statistics analyzed by using independent sample t- were performed using mean and standard deviations (SDs) (p. value ≤ 0.05) was considered to be significant.
All analyses were performed with statistical Package for the social sciences SPSS for Windows (version 23.0 SPSS Inc, Chicago, 111).

4. Results and Discussion:

4.1. Serum L-Arginine and L-Carnitine Concentrations:

The results showed a significant decrease (P≤0.05) in the serum l-arginine and l-carnitine levels in patients with Type2 DM compared with the control group as shown in table 2. There was a significant decrease (P≤0.05) in the serum l-arginine and l-carnitine levels in male patients with Type2 DM compared with male control. Also, table 2 showed a significant decrease (P≤0.05) in the serum l-arginine and l-carnitine levels in female patients with Type 2 DM compared with female control. There was no significant increase (P≤0.05) in the serum l-arginine level between male and female patients, while there was a significant increase (P≤0.05) in serum l-carnitine level in male patients with Type2 DM compared with female patients.

Table(1): L-arginine and L-carnitine levels in patients with type2 diabetes mellitus compared with the control group

<table>
<thead>
<tr>
<th>Groups</th>
<th>NO.</th>
<th>L-Arginine (µmole/L) Mean± S.D</th>
<th>L-Carnitine (µmole/L) Mean± S.D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>100</td>
<td>107.59 ± 9.75&lt;sup&gt;a&lt;/sup&gt;</td>
<td>56.48 ± 4.08&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Patients</td>
<td>100</td>
<td>88.03 ± 4.45&lt;sup&gt;b&lt;/sup&gt;</td>
<td>38.79 ± 4.18&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Male control</td>
<td>50</td>
<td>108.46 ± 9.78&lt;sup&gt;a&lt;/sup&gt;</td>
<td>56.64 ± 4.10&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Male patients</td>
<td>50</td>
<td>90.40 ± 3.13&lt;sup&gt;b&lt;/sup&gt;</td>
<td>40.41 ± 4.04&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Female control</td>
<td>50</td>
<td>106.71 ± 9.74&lt;sup&gt;a&lt;/sup&gt;</td>
<td>56.31 ± 4.09&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Female patients</td>
<td>50</td>
<td>85.66 ± 4.34&lt;sup&gt;b&lt;/sup&gt;</td>
<td>37.17 ± 3.70&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Male patients</td>
<td>50</td>
<td>90.40 ± 3.13&lt;sup&gt;a&lt;/sup&gt;</td>
<td>40.41 ± 4.04&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Female patient</td>
<td>50</td>
<td>89.66 ± 4.34&lt;sup&gt;a&lt;/sup&gt;</td>
<td>37.17 ± 3.70&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>
Increased catabolism of l-arginine, generally via Arginase, and decreased rate of endogenous l-arginine synthesis are situations that can cause Arginine shortage. Due to localized elevations in Arginase activity, conditions involving tissue or cellular arginine shortage (15).

The latest studies found that l-arginine supplementation increased glucose disposal rate (GDR) by 34%. l-arginine supplementation also improved insulin sensitivity in peripheral tissues by increasing glucose uptake from the circulation (16). Another clinical study looked at the ability and efficacy of l-arginine to prevent or delay Type2 DM in people with diabetes.

The excessive loss of human fluids containing carnitine, such as diarrhea, skin burns, or hemodialysis, can sometimes cause a reduction in serum carnitine content (17). Also Malnutrition causes a reduction in amino acids and vitamins necessary for carnitine production (18).

in various investigations the l-carnitine levels in the plasma and myocardium of diabetic animals have been found to be in lower levels compared with healthy animals. They also demonstrated that carnitine deficit and relative insufficiency may be an underappreciated factor in diabetes management (19). The lower levels of serum l-carnitine level in female patients with Type2 DM compared with male patients, this could be due to increased excretion through urine, also that secondary carnitine shortage a result of the body’s overuse of available carnitine, which occurs during pregnancy or lactation (20).

4.2. Serum Zinc, Magnesium, Chromium Concentrations:

The results showed a significant decrease (P≤0.05) in the serum zinc, magnesium, chromium levels in patients with Type2 DM compared with the control group as shown in table (1). Furthermore, there was a significant decrease (P≤0.05) in the serum zinc, magnesium, chromium levels in male patients with Type2 DM compared with male control. Also, table (1) showed a significant decrease (P≤0.05) in the serum zinc, magnesium, chromium levels in female patients with Type2 DM compared with female control. There was no significant increase (P≤0.05) in the serum magnesium and chromium levels between male and female patients, while there was a significant increase (P≤0.05) in serum zinc level in male patients with Type2 DM compared with female patients.

Table(2): Zinc, Magnesium and Chromium levels in patients with type2 diabetes mellitus compared with the control group

<table>
<thead>
<tr>
<th>Groups</th>
<th>NO.</th>
<th>Zn (µg/ml) Mean± S.D</th>
<th>Mg(mg/dl) Mean± S.D</th>
<th>Cr (µg/L) Mean± S.D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male patients</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female patients</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male control</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female control</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male patients</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female patients</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 1 l-arginine and l-carnitine levels in patients with type 2 DM compared with the control group
### Table 1

<table>
<thead>
<tr>
<th>Group</th>
<th>Value 1 (Mean ± S.D)</th>
<th>Value 2 (Mean ± S.D)</th>
<th>Value 3 (Mean ± S.D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>0.90 ± 0.12&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.99 ± 0.20&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.22 ± 0.04&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Patients</td>
<td>0.54 ± 0.08&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.58 ± 0.10&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.12 ± 0.02&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Male control</td>
<td>0.91 ± 0.10&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.99 ± 0.19&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.21 ± 0.03&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Male patients</td>
<td>0.58 ± 0.06&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.61 ± 0.09&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.11 ± 0.02&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Female control</td>
<td>0.88 ± 0.13&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.0 ± 0.21&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.22 ± 0.04&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Female patients</td>
<td>0.51 ± 0.08&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.59 ± 0.10&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.12 ± 0.03&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Male patients</td>
<td>0.58 ± 0.06&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.61 ± 0.09&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.11 ± 0.02&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Female patient</td>
<td>0.51 ± 0.08&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.59 ± 0.10&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.12 ± 0.03&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

**Figure 2** Zn, Mg, and Cr levels of patients with type 2 DM compared with the control group

Diabetics have a lower level of serum zinc, because zinc is a trace element that serves as an antioxidant in the human body, helping to minimize oxidative stress. Zinc deficiency has been linked to a variety of chronic diseases, including Type2 DM (21), where by increasing zinc excretion and limiting absorption from the intestines or by excretion from the kidneys, DM may induce a decrease in zinc levels in the body (21).

The results showed that females have lower mean serum zinc level than males in both control and diabetes groups, which could be explained by their lower mean zinc consumption (10.8 ± 3.8 mg vs. 13.0 ± 4.8 mg for cases and 11.4 ± 3.8 mg vs. 13.2 ± 4.7 mg for controls). This is in line with the findings of various national food surveys, which found that a large majority of women globally are at risk of zinc deficiency because they consume less zinc than recommended, in part due to the fact that they consume less food than men (22). Furthermore, the lower levels of serum magnesium in patients compared with control groups may be due to poor oral intake, increased renal loss, and persistent diarrhea associated with autonomic neuropathy are all factors. There was the possibility that magnesium could aid in the translocation of the glucose transporter number 4 (GLUT 4) to the cell membrane. This would take place by the activation of tyrosine kinase in the presence of Mg (23).
In a previous study, patients with Type2 DM had considerably lower serum chromium levels than the control group (24). This could be due to a variety of factors, including the type of food consumed and the source of the meal, both of which can influence the chromium level. Lack of exercise, refined sugar consumption, and white flour consumption (25, 26).

4.3. Biochemical parameters concentrations:

The results in table (3) showed a significant increase (P≤0.05) in the fasting blood glucose, serum insulin, serum c-peptide, HbA1c levels in patients with Type2 DM compared with the control group. Furthermore, there was a significant increase (P≤0.05) in the fasting blood glucose, serum insulin, serum c-peptide, HbA1c levels in male patients with Type2 DM compared with male control. Also, there was a significant increase (P≤0.05) in the fasting blood glucose, serum insulin, serum c-peptide, HbA1c levels in female patients with Type2 DM compared with female control. The results showed there was no significant increase (P≤0.05) in the serum insulin, and serum c-peptide levels between male and female patients, while there was a significant increase (P≤0.05) in serum fasting blood glucose, HbA1c levels in female patients with Type2 DM compared with male patients.

Table(3): Biochemical parameters in patients with type2 diabetes mellitus compared with the control group

<table>
<thead>
<tr>
<th>Groups</th>
<th>NO.</th>
<th>FBG (mg/dl) Mean± S.D</th>
<th>S. insulin (µU/ml) Mean± S.D</th>
<th>S. C-peptide (ng/ml) Mean± S.D</th>
<th>HbA1c% Mean± S.D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>100</td>
<td>87.04 ± 9.37&lt;sup&gt;b&lt;/sup&gt;</td>
<td>16.48 ± 3.64&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.66 ± 0.73&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.83 ± 0.96&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Patients</td>
<td>100</td>
<td>206.85 ± 33.34&lt;sup&gt;a&lt;/sup&gt;</td>
<td>27.48 ± 5.78&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.45 ± 0.81&lt;sup&gt;a&lt;/sup&gt;</td>
<td>9.09 ± 1.52&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Male control</td>
<td>50</td>
<td>87.46 ± 9.10&lt;sup&gt;b&lt;/sup&gt;</td>
<td>17.45 ± 3.15&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.07 ± 0.66&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4.14 ± 0.84&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Male patients</td>
<td>50</td>
<td>193.88 ± 27.63&lt;sup&gt;a&lt;/sup&gt;</td>
<td>29.46 ± 5.28&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.53 ± 0.81&lt;sup&gt;a&lt;/sup&gt;</td>
<td>8.50 ± 1.18&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Female control</td>
<td>50</td>
<td>86.62 ± 9.70&lt;sup&gt;b&lt;/sup&gt;</td>
<td>15.50 ± 3.87&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.25 ± 0.55&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.51 ± 0.98&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Female patients</td>
<td>50</td>
<td>219.82 ± 33.75&lt;sup&gt;a&lt;/sup&gt;</td>
<td>25.50 ± 5.63&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.37 ± 0.81&lt;sup&gt;a&lt;/sup&gt;</td>
<td>9.67 ± 1.61&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Male patients</td>
<td>50</td>
<td>193.88 ± 27.63&lt;sup&gt;a&lt;/sup&gt;</td>
<td>24.96 ± 5.28&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.53 ± 0.81&lt;sup&gt;a&lt;/sup&gt;</td>
<td>8.50 ± 1.18&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Female patient</td>
<td>50</td>
<td>219.82 ± 33.75&lt;sup&gt;b&lt;/sup&gt;</td>
<td>25.50 ± 5.63&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.37 ± 0.81&lt;sup&gt;a&lt;/sup&gt;</td>
<td>9.67 ± 1.61&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>
The reason for the increase in fasting blood glucose level in patients with Type2 DM is due to insulin resistance, which is a physiological condition in which insulin becomes less effective in lowering blood glucose levels. As a result of high blood glucose level can rise to several levels beyond the normal range and cause adverse health effects, Some types of cells such as muscle cells and fat cells need insulin to absorb glucose, and blood glucose levels will rise when these cells fail to respond appropriately to the insulin diffusion (27, 28).

In the presence of insulin, the liver helps to manage glucose levels by limiting glucose production. This natural reduction in the liver's glucose synthesis may not occur in insulin resistance, contributing to high blood glucose levels (29).

The results also showed that the increase in the fasting blood glucose level in female patients with Type2 DM compared with male patients is due to several reasons: women lose less weight than men, especially the harmful visceral fat mass (30). Also, women with Type2 DM but not men, exhibit a different body image perception than healthy women. At the same body image figure, they have considerably higher BMIs than women who do not have Type2 DM (31).

Sex differences describe biological differences between women and men. Differences in sex chromosomes, sex-specific gene expression of autosomes, sex hormones, and their influence on organ systems are responsible for these differences between men and women (32).

The increase in serum insulin level in patients with Type2 DM is related to anomalies in insulin action, or insulin secretion, and endogenous glucose production (33). Where the pancreas’ islet cells are capable of producing substantial amounts of insulin in a process known as compensatory hyperinsulinemia, but which the cells are unable to absorb or use effectively, also following receptor events fail, resulting in causing it to remain in the bloodstream and occur hyperglycemia and a reduction in the number of insulin receptors on the cell membrane. Insulin secretion is increasingly overstimulated as a result of chronic overstimulation. The beta-cell reserve decreases and eventually disappears (34).

A high levels of serum c-peptide means that the body has too much insulin, because serum c-peptide is secreted in equimolar levels to insulin. It may be indicative of Type2 DM, insulin resistance, a condition in which the body does not respond to insulin in the correct way. measuring it can assist assess how much of their own natural insulin a person is making, because serum c-peptide can assess a person's own insulin secretion and because the liver metabolizes a substantial and variable proportion of insulin produced into the portal vein but not metabolizes serum.
c-peptide. blood c-peptide may be a better indicator of portal insulin secretion than insulin itself (35, 36). there is no significant differences in the serum c-peptides concentration between male patients with Type2 DM compared with female patients.

glycated haemoglobin (HbA1c%) was first recognized as a "unusual" haemoglobin in diabetic patients (37). following that discovery, numerous minor studies connecting HbA1c% to glucose concentrations were done, leading to the conclusion that HbA1c% might be used as an objective indicator of glycemic management. HbA1c% represents the average plasma glucose level during the past 8 to 20 weeks ago (38). It can be done at any time of day and requires no particular preparation, such as fasting. Because of these characteristics, it has become the test of choice for determining glycemic control in diabetics. Recently, there has been a lot of interest in using it as a diabetes diagnostic test and as a diabetes screening test for people who are at infection risk (39).

The measurements clearly showed that the increase in the HbA1c% was accompanied by a significant increase (P≤0.05) in fasting blood glucose level in male and female patients with Type2 DM compared with the control group. while the results showed a significant increase (P≤0.05) in the HbA1c% in female patients with Type2 DM compared with male patients. This is due to the significant increase (P≤0.05) in fasting blood glucose level in female patients compared with male patients. Where HbA1c%, or the fraction of glycated hemoglobin, rises in a predictable pattern in response to plasma glucose levels (38, 40).

5. Conclusion
From our study it is concluded that diabetic patients have lowered levels of metals like ( zinc, magnesium, chromium) and amino acids like( arginine and carnitine) in blood compared with the healthy subjects, Also there was elevated of levels of fasting blood glucose, serum insulin, serum c-peptide and HbA1c .

6. Acknowledgments
The authors are very grateful to the referees for useful comments and suggestions towards the improvement of this paper.

7. References


