Effects of Ascorbic Acid on Insulin Resistance in Hyper Insulinemic and Euglycemic Persons

Muntadher H. Dawood[1], Taha H. Al-Yasiri[2]

[1] Lect., Department of Pharmacology and Toxicology, College of pharmacy, misan University, Iraq,
[2]Lect., Department of Sciences Basic College of Education, University of Misan Misan, Iraq

Abstract

This experiment was conducted in the city of Amara in southern Iraq at Al-Sadr Hospital. The study aimed to evaluate the effect of administering Ascorbic Acid on 50 diabeticpatients who had insulin resistance after they were diagnosed clinicallyof 25 patients were treated with Ascorbic acid at dose 500 mg twice a day for 12 days and the others 25 were considered as control.

The study group demonstrated a significant decrease in the fasting patient's blood sugar (F.B.S), insulin and fasting blood, and Insulin resistance at the end of 12 weeks (P0.05) as compared to baseline measurements. The reduction in F.B.S, Fasting Insulin, and Insulin resistance was significantly reduced in the ascorbic acid group at week 12 of the study relative to the control group (P <0.05).

Keywords*: Ascorbic acid, Insulin, diabetic, Blood sugar, Fasting*

Introduction

Insulin resistance is characterized by weakness of the biological responses for target tissue, mainly adipose tissue, liver and muscle, to insulin stimulation. Insulin resistance has inhibited elimination of glucose , resulting in a compensative rise in the insulin production from beta-cell and results hyperinsulinemia. [1][2] Hyperglycemia, hypertension, dyslipidemia, visceral adiposity and hyperurieimia, elevated inflammatory signs and impairment of the endothelial function, and prothrombic state can result in the metabolic sequel of insulin resistance which lead to metabolic syndrome, diabetes mellitus type 2 and non-alcoholic liver fat (NAFLD). [3,4]

Type 2 diabetes is the primary result of insulin resistance (T2DM). Resistance to insulin is thought to before T2DM production by 10 to 15 years. high level in the production of endogenous insulin results from growth compensatively of Insulin resistancewhich is associated with weight gain that occurs with an increase in the level of anabolic hormones (endogenous insulin) is associated with insulin resistance in turn, aggravate insulin resistance [5] This harmful cycle continues until the beta-cell function of the pancreas is unable to produce the insulin that meets the demand caused by insulin resistance, leading to hyperglycemia. With a The constant discrepancy observed between the demand for insulin from the body's cells and the production of insulin, blood sugar levels elevate to levels compatible with type 2 diabetes mellitus T2DM. [6]

Vitamin C is an antioxidant vitamin with water-soluble properties and an essential cofactor in the synthesis of carnitine, collagen and catecholamine metabolism and serves to absorb dietary iron. A person cannot synthesize or produce vitamin C; Therefore, they can only get it through food such as eating fruits and vegetables. [7]

Corresponding Author.
Muntadher H. Dawood
mntzrhnwn2@gmail.com

Citrus fruits, bananas, and green leafy vegetables such as onions and potatoes are a rich source of vitamin C, which is fully absorbed from food in the small intestine, and its absorption decreases with increasing concentration in the lumen of the intestine,[8] the residues of Proline amino acid that is find on procollagen allow vitamin C to be hydroxylated, making it possible to form a triple-helix for mature collagen. [9]

Skin integrity, blood vessels, bone, and mucous membranes, are impaired by the absence of a healthy triple-helical structure. scurvy is the sequel that result from vitamin C deficiency which presents with hematological abnormalities, hemorrhage and hyperkeratosis [10]

Aim of Study

The aim of the trial was to evaluate the effects of vitamin C administration on insulin resistance parameters in subjects with indications of increased insulin resistance.

Materials and Methods

Study design:

The current research was performed at Al-Sader Teaching Hospital on 50 individuals with hyper insulinimia and uglycemia (31 males, 19 females) aged)30-65(years. The patients were clinically diagnosed as having insulin resistance by the doctor. Criteria for the HOMA model-based diagnosis of insulin resistance.

In order to determine the effectiveness and ability of the medication used (vitamin C) in the study to change the habit of changing due to insulin resistance to the correct normal and to understand the true values of the research criteria, another 20 patients should be considered, in addition to (50) patients.

Patients:

In this pilot study,)25(patients were treated with ascorbic acid and changed lifestyle and diet control for)12(weeks. (500 mg), twice daily plus 12 weeks with dietary control and life style changes.

Sample Collection and Preparation:

Blood samples were obtained from all patients and healthy people after about 12 hours of fasting by taking a sample of venous blood (10 ml), before starting drug therapy (vitamin C) and (at zero) and after 12 weeks of treatment and then changes in Standards examined, blood patient samples were collected in spatial tubes, and after being centrifuged with the device at (3000) rpm for 10 minutes at 4 ° C.

In Eppendorf tubes, the plasma fraction obtained was divided into two sections and stored frozen before analysis was conducted.

Measurements:

Fasting blood sugar Level (FBS):

Using a ready-made kit for this reason, serum glucose level was assessed according to the technique [11], Based on glucose enzymatic oxidation to form hydrogen peroxide and glucuronic acid, accompanied spectrophotometrically at 505 nm by the subsequent reaction with phenol and formation of quinonimine. The results obtained were expressed as mg / dL, which corresponded to a normal glucose solution, which was treated with the same treatment.

Serum Insulin levels:

The Demeditec insulin ELISA, based on the sandwich concept, is an ELISA solid phase.

The microtiter holes are coated on the insulin molecule with antibody monoclonal directed toward a partially on site of antigenic with enzyme conjugate in the coated holes, A portion of the patient's sample containing internal insulin was incubated with anti-insulin antibodies linked with amino acid (biotin). The unbound conjugated antibodies were then washed from the hopper after they were incubated. Through the second incubation period cycle the Streptavidin-Peroxidase-Enzyme linked to the antibody of the biotin.

The mounting of thehorseradish peroxidase (H.R.P) complex is relative to the sample insulin concentration.

The strength of the color obtained after adding the substrate solution is in proportion to the amount of insulin concentration in the patient blood sample. The binding potential was expressed as uU / ml. The HOMA Model is a very simple and practical method for assessing insulin resistance and for testing insulin sensitivity and represents a type of glucose reaction.. This assay was then used to determine stable fasting glucose and insulin levels for a variety of insulin-resistant cell function groups. Both primary HOMA and modified HOMA2 are thought to be a feedback loop from the liver to the cell. [12,13]

Insulin-dependent HGP controls glucose concentrations, while the levels of Insulin to glucose depend on the reaction of the pancreatic B cells'. Deficient function of β-cell thus indicates a decreased reaction of β-cells to glucose-induced insulin secretion. Likewise, the diminished suppressive effect of insulin on HGP is expressed in insulin resistance. This glucose insulin homeostasis is defined by HOMA via a series of nonlinear equations derived empirically. For any interference in pancreatic cell activity and insulin sensitivity, the model used predicts steady levels of glucose and insulin in the blood. (14) For a fasting plasma analysis study that includes a constant and tests glucose (fasting plasma glucose; FPG) and insulin (fasting plasma insulin; FPI) the IR approximation equation has been simplifiedthe product of FPG'FPI-HOMA-IR = (glucose × insulin)/405 is the index of the IR.

It tests the concentration of insulin in uU/ml and glucose in mg/dl. A normalizing factor is the 405 constant, i.e. a normal FPI of 5 uU/mL 81 mg/dl normal FPG usual for a 'normal' healthy person = 405. Therefore, HOMA-IR =1 for a person with 'normal' insulin sensitivity.

Statistical Analysis

The dual t-test was used to compare the values of the result that taken from each group before and after treatment of ascorbic acid administration, and separate control t-tests were used to compare the values obtained for all patients and healthy subjects. In several comparisons to compare between groups in a variables differences before and after 12 weeks of treatment, post-hoc LSD variance analysis (ANOVA) was used. The data is provided in the form of means and standard deviations (SD).

Using a two-tailed test, $P<0.05$ was considered statistically relevant for all statistical analyses. Statistical data analysis was conducted using software version 16.0 of the Statistical Program for Social Sciences.

Results

Comparison of insulin resistance subjects and healthy subjects with respect to various parameters:

Mean± SD was determined for F.B.S, Fasting Serum. Insulin andInsulin reluctant, respectively, in apparently stable and patient groups, as shown in the following table. The baseline characteristics of the population of healthy and prediabetic patients were compared using the unpaired t-test.showing substantial differences in tolerance to F.B.S, Fasting S.Insulin and Insulin ($p<0.001$). As defined in the table.

As compared to baseline tests, the research group reported asubstantial lowering in F.B.S, Fasting Insulin, and Insulin Resistance in the 12 weeks of the end of experiment (P0.05).At week 12 of the trial, the ascorbic acid group had a significantly lower F.B.S, Fasting Insulin, and Insulin resistance than the control group (P0.05).

Table (1): The effect of research therapy on the study group after 12 weeks of therapy (fasting blood sugar, fasting insulin and insulin resistance) and multiple comparisons of the change from baseline

Group / parameters		Control		Ascorbic acid	
		mean	±SD	mean	±SD
F.B.S	Baseline	119.22	5.51	118.30	4.32
	12week	108.30*	4.87	88.71**	3.89
	ΔF.B.S	-10.92	0.64	-29.59a	0.43
Fast.In	Baseline	12.32	1.18	12.08	1.12
	12week	11.11*	1.12	8.51**	0.77
	ΔFast.In	-1.21	0.06	-3.57a	0.35
In.resi	Baseline	3.68	0.33	3.46	0.38
	12week	2.96*	0.31	1.76**	0.35
	ΔIn.resi	-0.72	0.02	-1.70a	0.03

*= statistically significant (P<0.05) difference in the paired t-test after 12 weeks relative to the baseline.

**= statistically significantly important (P<0.001) difference in the paired t-test after 12 weeks relative to the baseline.

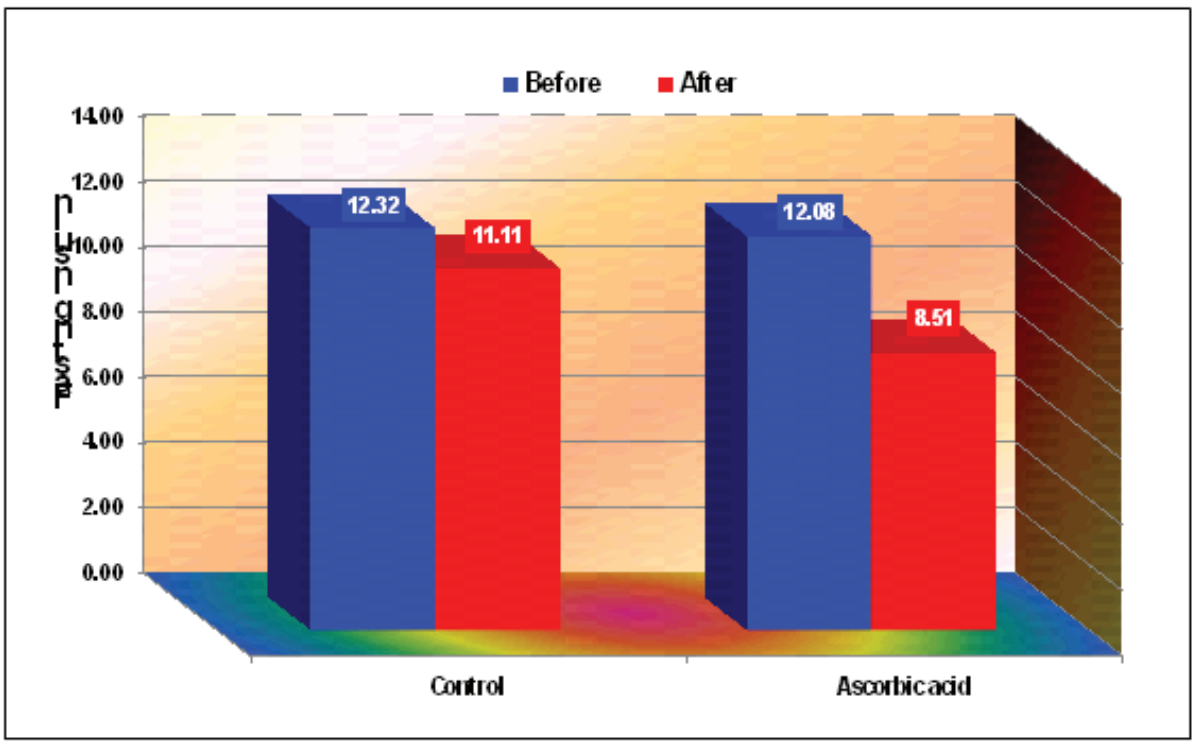

Figure (1): Fasting Insulin before and after 12 weeks of the study treatment

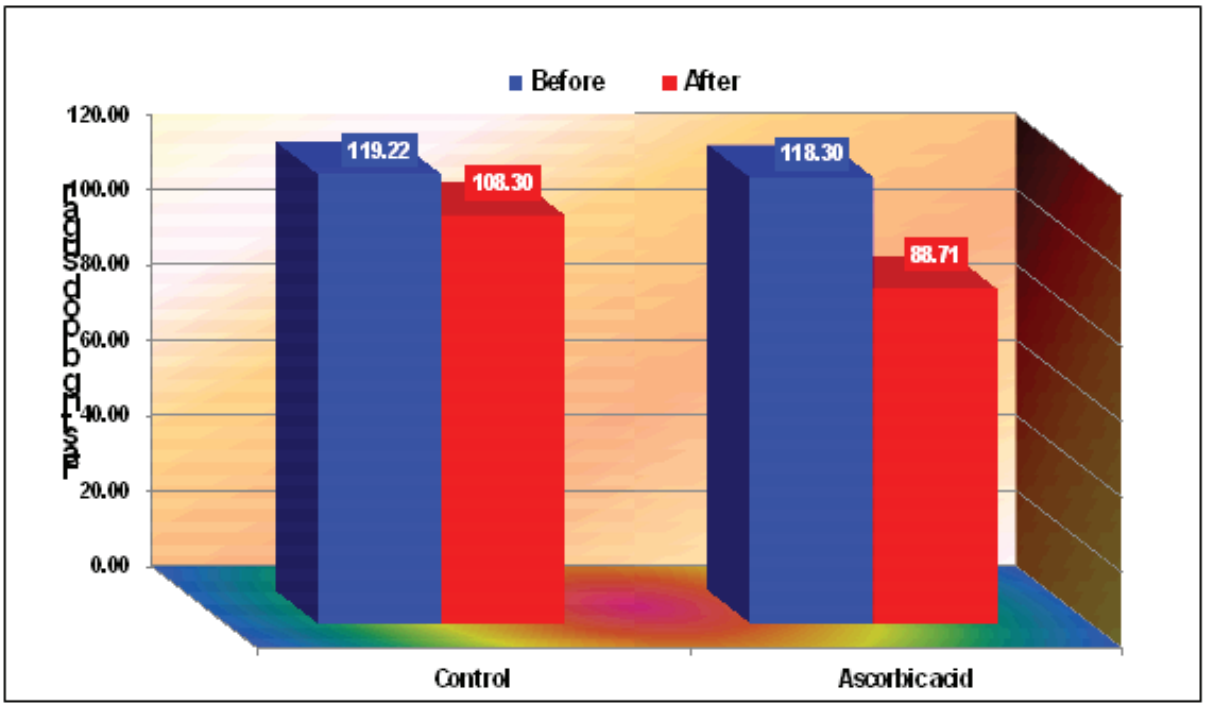

Figure (2): Fasting Insulin before and after 12 weeks of the study treatment

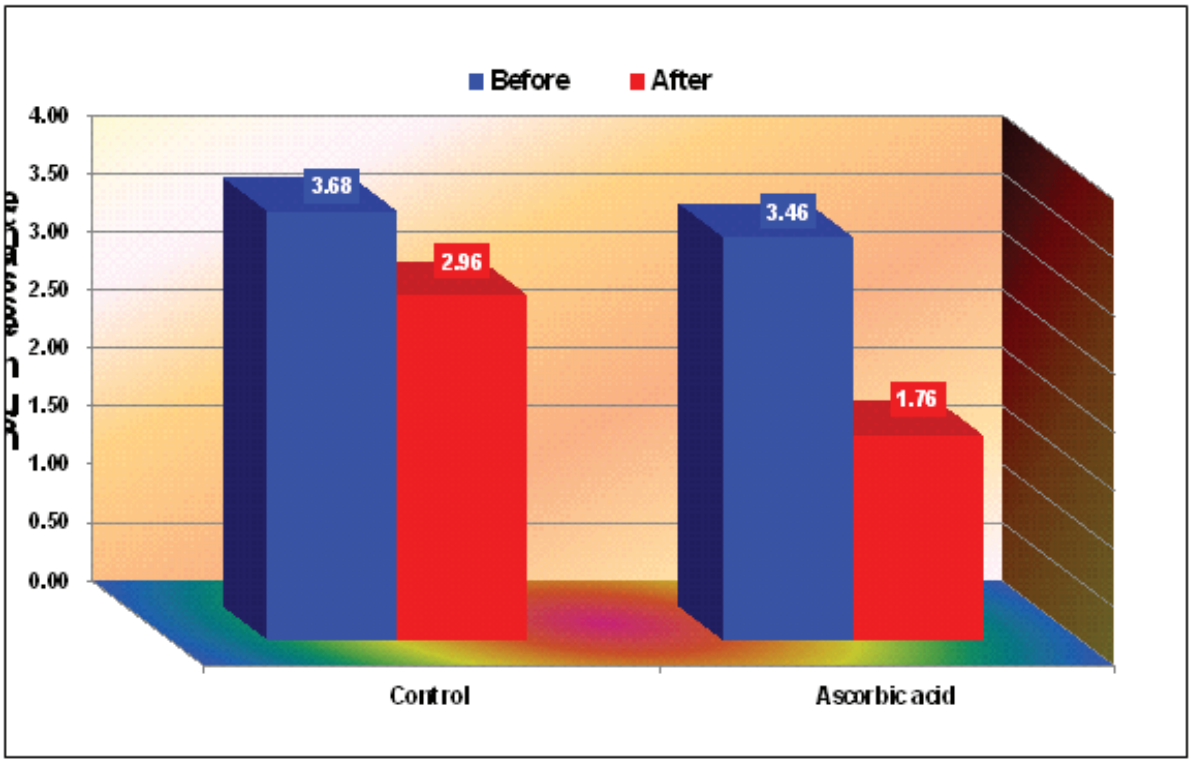

Figure (3): Changes in Fasting Insulin from the baseline to 12 weeks of the study

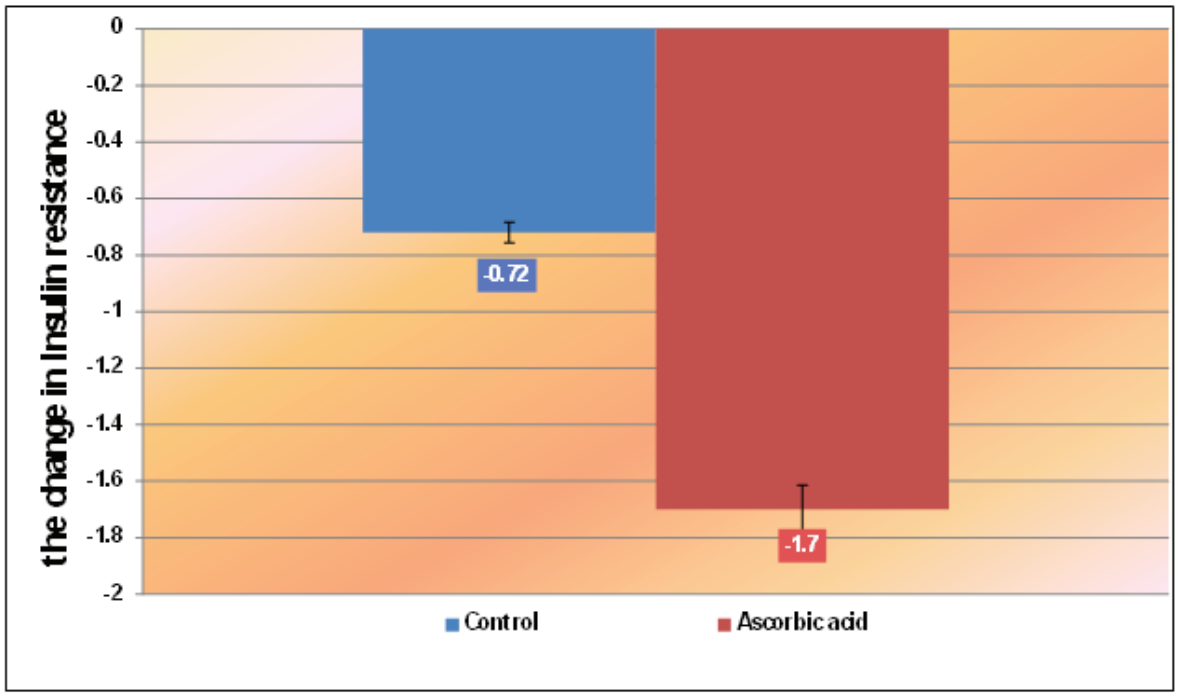

Figure (4): Changes in Insulin resistance from the baseline to 12 weeks

Discussion

As compared to baseline measures at the end of 12 weeks, the experiment showed a substantial lowering in F.B.S, Fasting Insulin, and Insulin Resistance (P0.05). Vitamin C is an important water-soluble micronutrient It is usually used traditionally for the prevention and treatment of scurvy. Vitamin C called sorbate or ascorbic acid has a universal role in both plants and animals. New fruits and vegetables are the main dietary sources of vitamin C. Based on many factors, vitamin C has been proposed to be helpful in reversing MetS- related with abnormalities. Body mass index (BMI), body fat percentage and waist circumference were inversely correlated with plasma vitamin C concentration. [15]

Important reductions in debits (blood glucose) 16.5, BP 18.25, TG and LDL-C 18.5 resulted from supplementation with vitamin C. Moreover, vitamin C is a potent antioxidant since it serves as a reducing agent that prevents oxidation of other compounds. [16]

Vitamin C scavenges harmful free radicals by contributing electrons, resulting in the stable and non-reactive ascorbyl radical. [17]

Vitamin C's ability to reduce oxidative stress has been documented in previous studies. Vitamin C affects neutrophil chemotaxis in response to inflammatory mediators, improves neutrophil microbe phagocytosis, and promotes macrophage neutrophil clearance, both of which help to reduce inflammation. [18,19]

Conclusions

It is easy to infer that vitamin C administration will enhance glycemic control with beneficial effects on insulin as a result. resistance in hyper-insulin and uglycemic individuals, according to the findings presented in this report.

Conflict of Interest – Nil

Source of Funding- Self

Ethical Clearance – Not required

References

1. Seong J, Kang JY, Sun JS, Kim KW. Hypothalamic inflammation and obesity: a mechanistic review. Arch Pharm Res. 2019 May;42(5):383-392.
2. Brown JC, Harhay MO, Harhay MN. The Value of Anthropometric Measures in Nutrition and Metabolism: Comment on Anthropometrically Predicted Visceral Adipose Tissue and Blood-Based Biomarkers: A Cross-Sectional Analysis. Nutr Metab Insights. 2019;12:1178638819831712.
3. Souza, M. R. D. A., Diniz, M. D. F. F. D. M., Medeiros-Filho, J. E. M. D., & Araújo, M. S. T. D. Metabolic syndrome and risk factors for non-alcoholic fatty liver disease. *Arquivos de gastroenterologia*, (2012) ; *49*(1), 89-96.
4. Henstridge DC, Abildgaard J, Lindegaard B, Febbraio MA. Metabolic control and sex: A focus on inflammatory-linked mediators. Br J Pharmacol. 2019 Nov;176(21):4193-4207.
5. Laursen TL, Hagemann CA, Wei C, Kazankov K, Thomsen KL, Knop FK, Grønbæk H. Bariatric surgery in patients with non-alcoholic fatty liver disease - from pathophysiology to clinical effects. World J Hepatol. 2019 Feb 27;11(2):138-149.
6. Rachdaoui, N. Insulin: the Friend and the foe in the development of type 2 diabetes mellitus. International journal of molecular sciences, (2020) ; 21(5), 1770.
7. Naidu, K. A. (2003). Vitamin C in human health and disease is still a mystery? An overview. Nutrition journal, 2(1), 1-10.
8. Abdullah, M., Jamil, R. T., & Attia, F. N. Vitamin C (ascorbic acid). (2020); *StatPearls [Internet]*.
9. Christiansen, H. E., Schwarze, U., Pyott, S. M., AlSwaid, A., Al Balwi, M., Alrasheed, S., ... & Byers, P. H. Homozygosity for a missense mutation in SERPINH1, which encodes the collagen chaperone protein HSP47, results in severe recessive osteogenesis imperfecta. The American Journal of Human Genetics, (2010); 86(3), 389-398.
10. Sandhu, S. V., Gupta, S., Bansal, H., & Singla, K. Collagen in health and disease. *Journal of Orofacial research*, (2012); 153-159.
11. Socha, K., Klimiuk, K., Naliwajko, S. K., Soroczyńska, J., Puścion-Jakubik, A., Markiewicz-Żukowska, R., & Kochanowicz, J. Dietary Habits, Selenium, Copper, Zinc and Total Antioxidant Status in Serum in Relation to Cognitive Functions of Patients with Alzheimer's Disease. Nutrients, (2021); 13(2), 287.
12. Matthews DR, Hosker JP, Rudenski AS, Naylor BA, Treacher DF, Turner RC. Homeostasis model assessment: insulin resistance and beta-cell function from fasting plasma glucose and insulin concentrations in man. Diabetologia; (1985); 28(7): 412–9.
13. Wallace TM, Levy JC, Matthews DR. Use and abuse of HOMA modeling. Diabetes Care; (2004); 27 (6): 1487–95. 14. Muniyappa, R., Lee, S., Chen, H., & Quon, M. J. Current approaches for assessing insulin sensitivity and resistance in vivo: advantages, limitations, and appropriate usage. American Journal of Physiology-Endocrinology and Metabolism, (2008); 294(1), E15-E26.
15. Khalife R, Grieco A, Khamisa K, Tinmouh A, McCudden C, Saidenberg E. Scurvy, an old story in a new time: The hematologist's experience. Blood Cells Mol Dis. 2019 May;76:40-44.
16 Wong, S. K., Chin, K. Y., & Ima-Nirwana, S. Vitamin C: A Review on its Role in the Management of Metabolic Syndrome. *International journal of medical sciences*, *17*(11), (2020); 1625–1638. https://doi.org/10.7150/ijms.47103
17. McRae MP. Vitamin C supplementation lowers serum low-density lipoprotein cholesterol and triglycerides: a meta-analysis of 13 randomized controlled trials. J Chiropr Med. 2008;7:48–58.
18. Padayatty SJ, Katz A, Wang Y. et al. Vitamin C as an antioxidant: evaluation of its role in disease prevention. J Am Coll Nutr. 2003;22:18–35.
19. Pehlivan FE. Vitamin C: An antioxidant agent. Vitamin C. 2017. p:23-35.