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Study of Malondialdehyde Level between Type-2 Diabetes Mellitus with and without Antioxidant Consumed Patients

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Abstract: ***The objective was to analysis MDA level in T2DM without and with antioxidant consumed patients. Among total 60 patients who were presented DM and employed in textile dying, handling of fabrics and stitching of fabrics in which thirty patients of DM as group A and thirty DM patients were consumed antioxidant as group B. The demographic and socioeconomic status along with biochemical profiles were estimated in both groups. The mean age and BMI were similar in both groups. For FBS (mg/dl), PPBS (mg/dl), HbA1c (%) and MDA (µmol/L) levels were decreased significantly (P<0.0001) in group B when compared to group A. Among the dietary antioxidants, the present findings observed beneficial to prevent DM among patients who consumed natural antioxidants for last one year. The combinations of dietary antioxidants have capability to reduce the blood parameters viz. FBS, PPBS, HbA1c and MDA in the present study. The mechanism behind the antioxidant performance is undefined in this study but these have found no side effects among patients who consumed natural antioxidants. In future, it is suggested a clinical trial to know the efficacy of natural antioxidants for DM management.***

Keywords: Type 2 diabetes mellitus, Occupational exposure, Dietary antioxidants, Diabetes prevention, Oxidative stress

1. Introduction

Type 2 diabetes mellitus (T2DM) is recognized as a genuine public health concern with a serious impact on human life. [1]It is a long-term chronic disease that occurs when our blood sugar (glucose) level is too high and eventually lead to circulatory, nervous and Immune system disorders. T2DM is more common among adults but children with obesity also suffer from type 2 diabetes. [2] There is no cure for T2DM but healthy lifestyle with proper exercises can help to manage the disease.

This chronic hyperglycemia is a hallmark of diabetes and the one of the major attributor to the numerous complications correlated with the disease. Many aspects of the pathophysiology of diabetes are still not clear, however, research indicates that oxidative stress plays a vital role in the emergence and development of this chronic condition. [3] Vascular endothelial cells are the key targets of hyperglycemic damage as they are incapable to regulate the intra-cellular glucose concentration and also, they cannot resist glucose from entering when bloodstream glucose concentrations are elevated. [4] Endothelial cells contain high glucose concentration, during hyperglycemia, and may suffer from notable oxidative stress. [5]

Malondialdehyde (MDA) obtained from lipid peroxidation of poly unsaturated fatty acids (PUFA) is an important compound that generally serves as one of the key markers for oxidative stress. [6] In other words, MDA is a steady end-product of lipid peroxidation. [7] It is formed by three carbon aldehyde which could exist in various forms in an aqueous solution. It is well established that serum MDA has been used as a biomarker of lipid peroxidation and has served as an indicator of free radical damage. [8]

Several studies revealed that MDA is a suitable biomarker in serum among diabetes patients and it is found in complicated diabetes with nephropathy comorbidity and non-complicated diabetic patient in comparison with healthy control. [9-12] Moreover, some studies indicated MDA level is also increased with duration of diabetes. [9, 11-14]

Generally, several natural products contain antioxidants. Many investigators studied regarding the antidiabetic activity of plants such as *Nerium oleander* Linn, [15] *Annona squamosa*, [16] *Cynodon dactylon*, [17] *Padina boergesenii*, [18] and *Tectona grandis* Linn., [19] *Moringa oleifera*, [20] which possess antioxidants activity and ultimately prevent T2DM. [21]Moreover, antioxidants are capable of inhibiting the oxidation of other molecules. From the previous study, it is well known that the medicinal plants with antioxidants activity are considered to prevent diabetes mellitus. [22]

In the present study, it was attempted to analysis MDA level in T2DM without and with antioxidant consumed patients.

2. Materials and Methods

Selection of study groups

In the present study, DM patients were included and categorized into 2 groups. Among total 60 patients who were presented DM and employed in textile dying, handling of fabrics and stitching of fabrics in which thirty patients of DM as group A and thirty DM patients were consumed antioxidant as group B.

Demographic and socioeconomic profiles of patients
For group A and group B patients, the demographic data viz. age, gender, education and occupation were collected from the patients.

Estimationof biochemical profile
As per history of diabetes patients were measured fasting blood sugar (FBS) and postprandial blood sugar (PPBS) was estimated by GOD-POD method [23] and Glycosylated haemoglobin (HbA1c) by Ion exchange resin method [24] for group A and group B separately. The oxidative stress parameter especially MDA was estimated as per the protocol of Ohkawa et al. [25]by using Kit (Elabscience MDA kit E-BC-K025-S) for group A and group B separately. The MDA concentration was expressed in terms of µmol/L

Obesity parameter
For obesity parameter, weight (Kg) was measured in electronic digital weighing machine and height (Cm) was estimated by using measuring scale. Body mass index (BMI) was calculated by using following formula:
BMI = weight (Kg) ÷ height (m^2)

Statistical analysis
Categorical variables were taken and expressed in percentage frequency distribution and continuous variable expressed as Mean ± SD and comparison were made between group A and group B patients as per student 't' test by using statistical tool. P value less than 0.05 considered as significant.

3. Results

Demographic and socioeconomic status of patients
Table 1 evaluates the frequency (%) distribution of demographic and socioeconomic status of patients.

In group A and B, the higher frequency value (14, 46.67%) was obtained for age groups of 41-55 years followed by 25-40 years (10, 33.33%) while lower frequency distribution (6, 20.0%) was obtained for age groups of >55 years. In group A and B, the higher frequency value (24, 80.0%) was obtained for males while lower frequency distribution (6, 20.0%) was obtained for females.

In group A and B, the higher frequency value (15, 50.0%) was obtained for dying followed by stitching (9, 30.0%) while lower frequency distribution (6, 20.0%) was obtained for fabric handling. In group A and Bfamily income (INR/annum), the higher frequency value (15, 50.0%) was obtained for ≥3 lakhs followed by ≤2 lakhs (8, 26.67%) while lower frequency distribution (7, 23.33%) was obtained for 2-3 lakhs.

Table 1: Demographic and socioeconomic status distribution

Age groups (Years)					
Group A	Frequency	%	Group B	Frequency	%
25-40	10	33.33	25-40	10	33.33
41-55	14	46.67	41-55	14	46.67
>55	6	20.00	>55	6	20.00
Total	**30**	**100.00**	**Total**	**30**	**100.00**
Gender					
Male	24	80.00	Male	24	80.00
Female	6	20.00	Female	6	20.00
Total	**30**	**100.00**	**Total**	**30**	**100.00**
Occupation					
Stitching	9	30.00	Stitching	9	30.00
Fabric handling	6	20.00	Fabric handling	6	20.00
Dying	15	50.00	Dying	15	50.00
Total	**30**	**100.00**	**Total**	**30**	**100.00**
Family income (INR/annum)					
≤2 lakhs	8	26.67	≤2 lakhs	8	26.67
2-3 lakhs	7	23.33	2-3 lakhs	7	23.33
≥3 lakhs	15	50.00	≥3 lakhs	15	50.00
Total	**30**	**100.00**	**Total**	**30**	**100.00**

Obesity parameters of patients
Table 2 evaluates the frequency (%) distribution of obesity parameters of patients. The height (Feet) distribution indicated in group A, the higher frequency value (23, 76.67%) was obtained for >5.5 while lower frequency distribution (7, 23.33%) was obtained for 5.1-5.5. In group B, the higher frequency value (24, 80.0%) was obtained for >5.5 while lower frequency distribution (6, 20.0%) was obtained for 5.1-5.5. The weight (Kg) distribution indicated in group A and B, the higher frequency value (18, 60.0%) was obtained for >60 while lower frequency distribution (12, 40.0%) was obtained for ≤60.

Table 2: Obesity parameters distribution

Height (Feet)					
Group A	Frequency	%	Group B	Frequency	%
5.1-5.5	7	23.33	5.1-5.5	6	20.00
>5.5	23	76.67	>5.5	24	80.00
Total	**30**	**100.00**	**Total**	**30**	**100.00**
Weight					
≤60	12	40.00	≤60	12	40.00
>60	18	60.00	>60	18	60.00
Total	**30**	**100.00**	**Total**	**30**	**100.00**
BMI (Kg/m^2)					
18.5-24.9 (Healthy)	28	93.33	18.5-24.9 (Healthy)	28	93.33
25.0-29.9 (Overweight)	2	6.67	25.0-29.9 (Overweight)	2	6.67
≥30 (Obese)	0	0.00	≥30 (Obese)	0	0.00
Total	**30**	**100.00**	**Total**	**30**	**100.00**

Biochemical profiles of patients
Table 3 evaluates the frequency (%) distribution of biochemical profiles of patients. The FBS (mg/dl) distribution indicated in group A, the higher frequency value (28, 93.33%) was obtained for >120while lower frequency distribution (2, 6.67%) was obtained for <120. In group B, the frequencies were almost half (15, 50.0%) was obtained for >120 and <120. The PPBS (mg/dl) distribution indicated in group A, the frequencies were almost half (15, 50.0%) was obtained for 140-300 and >300. In group B, higher

frequency was observed for 140-300 (28, 93.33) while lower frequency distribution (2, 6.67%) was obtained for >300. The HbA1c (%) distribution indicated in group A, the frequency was higher (29, 96.67%) was obtained for >7.0 while lower in ≤7.0 (1, 3.33%). In group B, higher frequency was observed for ≤7.0 (25, 83.33%) while lower frequency distribution (5, 16.67%) was obtained for >7.0. The MDA (µmol/L) distribution indicated in group A, the frequency was higher (300, 100.0%) was obtained for >1.34. In group B, higher frequency was observed for 0.32-1.34 (24, 80.0%) while lower frequency distribution (6, 20.0%) was obtained for >1.34.

Table 3: Biochemical profiles distribution

FBS (mg/dl)					
Group A	Frequency	%	Group B	Frequency	%
≤120	2	6.67	≤120	15	50.00
>120	28	93.33	>120	15	50.00
Total	**30**	**100.00**	**Total**	**30**	**100.00**
PPBS (mg/dl)					
140-300	15	50.00	140-300	28	93.33
>300	15	50.00	>300	2	6.67
Total	**30**	**100.00**	**Total**	**30**	**100.00**
HbA1c (%)					
≤7.0	1	3.33	≤7.0	25	83.33
>7.0	29	96.67	>7.0	5	16.67
Total	**30**	**100.00**	**Total**	**30**	**100.00**
MDA (µmol/L)					
0.32-1.34	0	0.00	0.32-1.34	24	80.00
≥1.34	30	100.00	≥1.34	6	20.00
Total	**30**	**100.00**	**Total**	**30**	**100.00**

Table 4 describes comparative analysis of mean ± SD of age and clinical parameters between diabetic patients without (group A) and with antioxidant consumed (group B) patients. The mean age was similar in both groups. For FBS (mg/dl), a highly significant (P<0.0001) reduction was observed in group A (153.33 ±21.08) when compared to group B (120.57±17.32). For PPBS (mg/dl), a highly significant (P<0.0001) reduction was observed in group A (308.83 ±52.33) when compared to group B (233.07±39.72). For HbA1c (%), a highly significant (P<0.0001) reduction was observed in group A (8.00 ±0.68) when compared to group B (6.79±0.30). For MDA (µmol/L), a highly significant (P<0.0001) reduction was observed in group A (1.82 ±0.16) when compared to group B (1.24±0.12). The mean BMI was similar in both groups.

Table 4: Comparative analysis of mean age and clinical parameters between diabetic patients without and with antioxidant consumed patients

Parameters (Mean ± SD)	Group A (n = 30)	Group B (n =30)	P-value
Age (Years)	44.90 ± 9.52	44.90±9.52	---
FBS (mg/dl)	153.33 ±21.08	120.57±17.32	0.0001
PPBS (mg/dl)	308.83 ±52.33	233.07±39.72	0.0001
HbA1c (%)	8.00 ±0.68	6.79±0.30	0.0001
MDA (µmol/L)	1.82 ±0.16	1.24±0.12	0.0001
BMI (Kg/m^2)	21.61 ±2.95	21.61±2.95	---

4. Discussion

In the present study, all the biochemical profiles such as FBS, PPBS HbA1c and oxidative stress marker MDA level were found a significantly decreasing trend in T2DM patients who had consumed antioxidant for a year.

Generally, antioxidants such as vitamins A, C, and E, glutathione, alpha-lipoic acid, carotenoids, and coenzyme Q are well known. [21] Other types of antioxidants are included biflavonoids, minerals (copper, zinc, manganese, and selenium), and cofactors (folic acid, vitamins B1, B2, B6 and B12). These antioxidants play synergistically with each other using different mechanisms to scavenge different free radicals and repair the oxidative stress. [26]Majority of the drugs currently used in the treatment of DM have antioxidant activities in addition to their primary pharmacological activity. Earlier studies reported that aminoguanidine has been shown to exhibit free radical scavenging properties and inhibit lipid peroxidation. [27-33]

Moreover, abovementioned antioxidants derived from the diet. On the other hand, exogenous antioxidants can be compensated for the lower plasma antioxidant levels frequently observed in T2DM and in pre-diabetic individuals, whether their diabetes is primarily genetic in origin or due to obesity and a inactive lifestyle. [34]All of these natural antioxidants were found in vegetables and fruits, which guarantees health benefits associated with its consumption.

In an earlier prospective cohort study, vitamin C intake was found to be significantly lower among incident cases of T2DM. [35]In another prospective study cohort of >4000 non-diabetic subjects over 23 years, vitamin E intake was significantly associated with a reduced risk of T2DM. [36]

An earlier study reported that the level of glucose significantly decreased, and the oral glucose tolerance test (OGGT) improved in diabetic condition by supplementation of Vitamin E, [37] which is supported the present study. Moreover, HbA1c was significantly reduced after one-year consumption of antioxidants. [38] A study of Pieme et al. reported that DM patients had higher HbA1c level compared to healthy control. [39]

Several studies revealed that MDA is a suitable biomarker in serum among DM patients and it is elevated in complicated and non-complicated compared to healthy control. [9-12] Moreover, some studies indicated MDA level is also increased with duration of diabetes. [9, 11-14]A study of Piemeet al. reported that DM patients had higher MDA level compared to healthy control. [39] In the present study, dietary antioxidants reduced the MDA level, which prevent oxidative stress in DM patients and lowering the associated parameters viz. FBS, PPBS and HbA1c.

5. Conclusion

Among the dietary antioxidants, the present findings observed beneficial to prevent DM among patients who consumed natural antioxidants for last one year. It is evident that dietary supplementation of natural antioxidants such as Vitamin E, C, alpha-lipoic acid, etc. reduced the blood parameters viz. FBS, PPBS, HbA1c and MDA in the present study. The mechanism behind the antioxidant performance is undefined in this study but these have found no side effects

among patients who consumed natural antioxidants. In future, it is suggested a clinical trial to know the efficacy of natural antioxidants for DM management.

Conflict of interest

Authors declare no conflict of interest.

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References

[1] "Type 2 Diabetes-Symptoms and Causes. " Mayo Clinic, https: //www.mayoclinic. org/diseases-conditions/type-2-diabetes/symptoms-causes/syc-20351193. Accessed 16 Apr.2022.

[2] Harrington, Jm. "Reviews : Occupational Health Decennial Supple Ment. Frances Drever (Ed.). Office of Population Censuses and Surveys and the Health and Safety Executive. London: HMSO, 1995. E29.00. ISBN 0-11-691618-4. " Health Education Journal, vol.54, no.3, Sept.1995, pp.381–82.

[3] "Epidemiology of Type 2 Diabetes – Global Burden of Disease and Forecasted Trends: " Journal of Epidemiology and Global Health, vol.10, no.1, 2019, p.107.

[4] Kaiser, Nurit, et al. "Differential Regulation of Glucose Transport and Transporters by Glucose in Vascular Endothelial and Smooth Muscle Cells. " Diabetes, vol.42, no.1, Jan.1993, pp.80-89.

[5] Burgos-Morón, Estefania, et al. "Relationship between Oxidative Stress, ER Stress, and Inflammation in Type 2 Diabetes: The Battle Continues. " Journal of Clinical Medicine, vol.8, no.9, Sept.2019, p.1385.

[6] Sumathi K, Dilliraj C, Chaganti S, Lalitha S. Use of malondialdehyde (MDA) as a screening tool for vestibulopathy in Type 2 diabetes mellitus. Biomedicine.2021; 41 (3): 576-9.

[7] Mahreen R, Mohsin M, Nashreen Z, Siraj M, Ishaq M. Significantly increased levels of serum malondialdehyde in type 2 diabetics with myocardial infarction. Int J Diab Ctries.2010; 30: 49.

[8] Surapon T, Praparporn P, Orathai T, Viruch S. Serum levels of malondialdehyde in type 2 diabetes mellitus Thai subjects. Siriraj Medical Journal.2009; 61: 20-23.

[9] Kornelia Z, Kornatowska K, Luciak M, Blaszczyk J, Pawalak W. Lipid peroxidation and activities of antioxidant enzymes in erythrocytes of patients with non-insulin dependent diabetes with or without diabetic nephropathy. Nephrol Diab Transplant.1998; 13: 2829-32.

[10] Bhatia S, Shukla R, Venkata Madhu S, Kaur Gambhir J, Madhava Prabhu K. Antioxidant ststus, lipid peroxidation and nitric oxide endproducts in patients of type 2 diabetes mellitus with nephropathy. Clin Biochem.2003; 36 (7): 557-62.

[11] Apakkan Aksun S, Ozmen B, Parildar Z, Senol B, Habif S, Mutaf I, et al. Serum and urinary nitric oxide in type-2 diabetes with or without microalbuminuria: relation to glomerular hyperfilteration. J diabetes complication 2003; 17 (6): 343-8.

[12] Rani K, Gavel P, Bharti S. MDA, oxidative stress marker-role in diabetic nephropathy with special reference to type ii diabetes mellitus. Indian Journal of Applied Research.2016; 6 (5): 128-30.

[13] Nakhjavani M, Esteghamati A, Nowroozi S, Asgarani F, Rashidi A, Khalilzadeh. Type 2 diabetes mellitus duration: an independent predictor of serum malondialdehyde levels. Singapore Med J.2010; 51 (7): 582-6.

[14] Vivian ST, Jayprakash Murty DSK, Dattatreya, Suresh Babu P, Smilee Johncy S. Impaired antioxidant defense mechanism in diabetic retinopathy. Journal of Clinical and Diagnostic Research.2010; 4: 3430.

[15] Fartyal M. *Nerium Oleander* Linn. In vitro alpha amylase inhibitory potential of stem and root extracts. Int J Curr Pharm Res.2016; 9: 37-41.

[16] Kaleem M, Asif M, Ahmed QU, Bano B. Antidiabetic and antioxidant activity of *Annona squamosa* extract in streptozotocin-induced diabetic rats. Singapore Med J.2006; 47: 670-5.

[17] Ramya SS, Vijayanand N, Rathinavel S. Antidiabetic activity of *Cynodon dactylon* (L.) Pers. extracts in alloxan induced rats. Int J Pharm Pharm Sci.2014; 6: 348-52.

[18] Senthilkumar P, Sudha S, Prakash S. Antidiabetic activity of aqueous extract of *Padina boergesenii* in streptozotocin-induced diabetic rats. Int J Pharm Pharm Sci.2014; 6: 418-422.

[19] Rajaram K. Antioxidant and antidiabetic activity of *Tectona grandis* Linn. in alloxaninduced albino rats. Asian J Pharm Clin Res.2013; 6 Suppl 3: 174-7

[20] Zainab B, Ayaz ZS, Alwahibi M. S. Khan S, Rizwana H, Soliman DW, et al. In-silico elucidation of *Moringa oleifera* phytochemicals against diabetes mellitus. Saudi Journal of Biological Sciences.2020; 27 (9): 2299-2307.

[21] Rajendiran D, Packirisamy S, Gunasekaran K. A review on role of antioxidants in diabetes. Asian J Pharm Clin Res.2018; 11 (2): 48-53.

[22] Kelly FJ. Use of antioxidants in the prevention and treatment of disease. J Int Fed Clin Chem 1998; 10: 21-3.

[23] Trinder P. Determination of glucose in blood using glucose oxidase with an alternative oxygen acceptor. Ann Clin Biochem.1969; 6: 24-7.

[24] Trivelli, Liliana A, Helen M, Ranney, Hong Tien L. Hemoglobin components in patients with diabetes mellitus. N Eng J med.1971; 284: 353-7.

[25] Ohkawa H, Ohishi N, Yagi K. Assay for lipid peroxides in animal tissues by thiobarbituric acid reaction. Anal Biochem 1979; 95: 351-8. Ohkawa H, Ohishi N, Yagi K. Assay for lipid peroxides in animal tissues by thiobarbituric acid reaction. Anal Biochem.1979; 95: 351-8.

[26] Maritim A, Sanders R, Watkins J. I. Effects of alpha-lipoic acid on biomarkers of oxidative stress in streptozotic-induced diabetic rats. Journal of Nutrition and Biochemistry.2003; 14 (5): 288-294.

[27] Saxena A. K, Saxena P, Kale R. K and Baquer N. Z. Impaired antioxidant status in diabetic rat liver: Effect of vanadate. Biochemical Pharmacology.1993; 45: 539–542.

[28] Biegelsen E. S and Vita J. A. Human studies of antioxidants and vascular function. In:
[29] Keaney Jr. JF, editor. Oxidative stress and vascular disease. Dordrecht: Kluwer Academic Publishers: 1999; 213-243.
[30] Gaziano J. M. Antioxidants and cardiovascular disease. In: Keaney Jr. JF, editor. Oxidative stress and vascular disease. Dordrecht: Kluwer Academic Publishers: 1999; 245-258.
[31] Kern T. S, Tang J, Mizutani M, Kowluru R. A, Nagaraj R. H, Romeo G., Podesta F., and
[32] Lorenzi M. Response of capillary cell death to aminoguanidine predicts the develop-ment of retinopathy: comparison of diabetes and galactosemia. Investigative Oph-thalmology and Visual Science.2000; 41: 3972-3978.
[33] Dobsak P., Courderot-Masuyer C., Siegelova J, Svacinova H., Jancik J., Vergely-Vanriessen C., Rochette. Antioxidant properties of aminoguanidine: a paramagnetic resonance test Scripta Medica (BRNO).2001; 74 (1): 45-50.
[34] El-Shazly A. M, Mahmoud A. M, and Darwish N. S. Potential prophylactic role of ami-noguanidine in diabetic retinopathy and nephropathy in experimental animals. Acta Pharmaceutica.2009; 59: 67-73.
[35] Ruhe RC, McDonald RB. Use of Antioxidant Nutrients in the Prevention and Treatment of Type 2 Diabetes. J Am Coll Nutr.2001; 20: 363S-9.
[36] Feskens EJ, Virtanen SM, Rasanen L, Tuomilehto J, Stengård J, Pekkanen J, et al. dietary factors determining diabetes and impaired glucosetolerance: A 20-year follow-up of the Finnish and Dutch cohorts of the Seven Countries Study. Diabetes Care.1995; 18: 1104-12.
[37] Montonen J, Knekt P, Jarvinen R, Reunanen A. Dietary Antioxidant Intake and Risk of Type 2 Diabetes. Diabetes Care.2004; 27: 362-6.
[38] Al Shamsi MS, Amin A, Adeghate E. Beneficial effect of vitamin E on the metabolic parameters of diabetic rats. Mol Cell Biochem 2004; 261: 35-42.
[39] Pieme CA, Tatangmo JA, Simo G, Biapa Nya PC, Ama Moor VJ, Moukette Moukette B, et al. Relationship between hyperglycemia, antioxidant capacity and some enzymatic and non-enzymatic antioxidants in African patients with type 2 diabetes. BMC Res Notes.2017; 10 (1): 141.