ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)

IJDSIR : Dental Publication Service

Available Online at: www.ijdsir.com

Volume – 3, Issue – 4, August - 2020, Page No. : 428 - 434

Comparison of antioxidant potential of lycopene and melatonin in chronic periodontitis patients

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Citation of this Article: Dr. Shifa Fathima, Dr. Uma Sudhakar, Dr. S Gopalakrishnan, Dr. Gd Gomathi, Dr. Kavya Balan, Dr. Sayeed Farzana Begum, "Comparison of antioxidant potential of lycopene and melatonin in chronic periodontitis patients", IJDSIR- August - 2020, Vol. – 3, Issue -4, P. No. 428 – 434.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Introduction: Oxidative stress is an imbalance between the production of a reactive oxygen species and the antioxidant defense, leading to tissue damage. Lycopene is a hydrocarbon carotenoid while melatonin is a natural neurotransmitter like compound. Both are active scavengers of highly toxic free radicals which are generated during lipid peroxidation and stimulates antioxidant enzyme like superoxide dismutase.

Objective: To evaluate the effect of melatonin as an antioxidant compared to lycopene in subjects with chronic periodontitis.

Methodology: The participants were assigned to 3 groups with 5 subjects each– Group I included subjects who underwent SRP (Scaling and Root Planing), Group II included subjects who underwent SRP and supplemented with lycopene 10 mg daily at night for 4 weeks, Group III included subjects who underwent SRP and supplemented with tablet melatonin 3 mg daily at night for 4 weeks. The blood serum samples were collected at baseline and 4 weeks after SRP to estimate malondialdehyde and superoxide dismutase levels.

Results: It was demonstrated that there was considerable oxidative stress in periodontitis patients, as established by high serum malondialdehyde levels, which was reduced significantly by both melatonin and lycopene reflecting their antioxidant potential.

Conclusion: Melatonin acts as an antioxidant in the patients with periodontitis which had a positive effect on biochemical parameters of periodontitis, conferring a new facet to the management of periodontitis and an attempt to impede the disease progression.

Keywords: melatonin, lycopene, antioxidants, periodontitis, oxidative stress, reactive oxygen species, superoxide dismutase, malondialdehyde.

Introduction

Periodontitis is regarded as an inflammatory lesion, mediated by complex host parasite interactions, that leads to the loss of connective tissue attachment to root surface cementum and adjacent alveolar bone. [1,2]

A homeostatic imbalance between Reactive Oxygen Species (ROS) and antioxidant defense systems can trigger an oxidative stress response, which is believed to be related to periodontal destruction. [3] Until now, primary clinical weapons against periodontal disease have been scaling and root planning (SRP), antibiotics and surgery. Antioxidants, if given, can act systemically to support the body's natural immune system.

Oxidative stress is an imbalance between the production of a ROS and the antioxidant defense, leading to tissue damage. Both melatonin and lycopene are active scavengers of highly toxic free radicals which are generated during lipid peroxidation like Malondialdehyde (MDA) and stimulates antioxidant enzyme like Superoxide Dismutase (SoD).

Lycopene is an effective natural antioxidant and most efficient biological carotenoid exhibiting highest physical quenching rate with singlet oxygen. [4] It reverses the DNA damage induced by hydrogen peroxide. Serum and tissue lycopene levels are inversely related to chronic disease risk. Lycopene participates in a cascade of chemical reactions, protecting critical cellular biomolecules, including lipids, proteins, and DNA [5] and believed to reduce the risk of cardiovascular disease, cancer, osteoporosis, and in some cases, even male infertility. Lycopene has the uncommon feature of becoming bound to chemical species that react to oxygen, thus being the most efficient biological antioxidizing agent. Due to this property, studies have been enthusiastically conducted with lycopene, in order to find out whether or not it could be an alternative to protect patients against the damaging effects of free radicals. [6]

Melatonin is a natural neurotransmitter like compound produced primarily by pineal gland. [7] Melatonin is identified as a powerful direct free radical scavenger and indirect antioxidant. [8] Melatonin reduces oxidative stress by several means. It is an active scavenger of both the highly toxic hydroxyl radical (OH), produced by electron reduction of oxygen and peroxy radical which is generated during unsaturated lipid peroxidation. Melatonin also stimulates some important antioxidant enzymes, i.e., SoD, Glutathione Peroxidase (GPx) and glutathione reductase. [9] Melatonin additionally may stimulate the proliferation and synthesis of type I collagen and bone formation. [10] Furthermore, many studies have proved that salivary, melatonin level varies according to the degree of periodontal disease indicating that salivary melatonin may act to protect the body from external body insults. Therefore, melatonin supplementation, i.e., synthetic version of hormone melatonin may be potentially valuable in the treatment of periodontal diseases. [9] Considering the mentioned functions of melatonin, this study was designed to evaluate the ability of melatonin supplementation to raise the antioxidant capacity levels, to reduce lipid peroxidation and thereby to reduce the periodontal inflammation.

Literature is deficient in the studies regarding the effect of lycopene and melatonin on periodontal health, hence the present study aims to compare the efficacy of melatonin and lycopene supplementation as antioxidants in periodontal diseases. Present study was designed with an objective to determine the effect of melatonin and lycopene on lipid peroxidation and antioxidant enzymes in periodontal disease.

Materials And Methods

The present study was approved by the Institutional Review Board, Dr. MGR educational and research institute, Chennai, Tamil Nadu, India. The complete procedure was explained, and informed consent was signed from all included study participants. A total of 30 patients were included, comprising of both sexes aged ≥30 years with a periodontal pocket depth (PPD) of 4mm to 5mm, and clinically diagnosed with Generalized Chronic Periodontitis. Exclusion criteria were pregnant and lactating women; smokers; any medical conditions requiring prophylactic antibiotic cover before dental treatment; periodontal treatment given in the past 6 months; and presence of systemic conditions that could affect the progression of periodontal disease or other inflammatory conditions.

The participants were assigned to 3 groups with 10 subjects each– Group I included subjects who underwent SRP (Scaling and Root Planing) alone, Group II included subjects who underwent SRP and supplemented with lycopene 10 mg daily at night for 4 weeks, Group III included subjects who underwent SRP and supplemented with tablet melatonin 3 mg daily at night for 4 weeks.

SRP was performed under local anaethesia using gracey curettes. Supplements used in the study were commercially available lycopene 10 mg (Healthvit Lycopene 10000 MCG) and melatonin 3 mg (meloset).

The blood samples were collected at baseline and SRP was performed after 24hrs.blood samples were again collected 4 weeks after SRP and checked for MDA levels and SoD levels. Blood samples were collected by venipuncture of antecubital vein. 5ml of blood was collected. Ten minutes after collection, it was subjected to centrifugation at 3000 rpm for 10 min; the serum was separated and collected in two storage vials for serum MDA and serum SOD estimation. MDA and SOD was assessed by spectrophotometric estimation of serum Thio Barbituric Acid Substances (TBARS) assay [11] and SOD assay kit, respectively.

Statistical analysis

All collected data were analyzed using SPSS software. Results were expressed in means and standard deviations. Intragroup comparisons were performed using paired t test and intergroup comparisons at each interval was performed by Kruskal wallis test. For all analyses, $P < 0.05$ was considered to be statistically significant.

Results

There was no significant difference in both MDA and SoD levels between all the three groups with $p<0.05$ at baseline (table 1). After 4 weeks, there was no significant difference among the three groups in the levels of MDA and SoD (table 2). There was a significant reduction in the MDA levels in GROUP III and GROUP II than GROUP (figure 1). There was not much of a significant difference between GROUP II and GROUP III. Also, a significant increase in the SoD levels in GROUP III than GROUP I and GROUP II (figure 2). Intra group comparison showed that the MDA levels were highly significant between baseline and 4 weeks (table 3). Similarly, intra group comparison of SoD levels between baseline and 4 weeks were highly significant (table 4).

Table 1: Inter Group Comparison of MDA And Sod At Baseline Between All The Three Groups.

	Group I	Group II	Group III	p-value
MDA	1.41 ± 0.15	1.39 ± 0.15	1.43 ± 0.20	0.93
SoD	140.53 ± 37.11	110.28 ± 32.36	129.91 ± 27.54	0.26

MDA expressed as nmoles/min/mg protein

SoD expressed as U/min/mg protein

Table 2: Inter Group Comparison of MDA And Sod After Four Weeks Between All The Three Groups.

	Group I	Group Ii	Group III	p-value
MDA	1.01 ± 0.14	0.78 ± 0.14	0.84 ± 0.14	0.1
SoD	163.45 ± 35.34	139.77 ± 35.91	174.64 ± 27.19	0.12

Table 3: Intra Group Comparison of MDA between Baseline and Four Weeks

		Mean	Std. Deviation	t	p-Value
MDA	Group I	0.40	0.22	4.03	.016
	Group II	0.61	0.11	12.64	.000
	Group III	0.57	0.10	13.32	.000

Table 4: Intra Group Comparison of Sod between Baseline and Four Weeks

		Mean	Std. Deviation	t	p-Value
SoD	Group I	22.91	4.04	12.68	.000
	Group II	29.49	4.40	14.98	.000
	Group III	44.72	10.40	9.61	.001

Figure 1: Mean Values of MDA at Baseline and 4 Weeks in All The Three Groups.

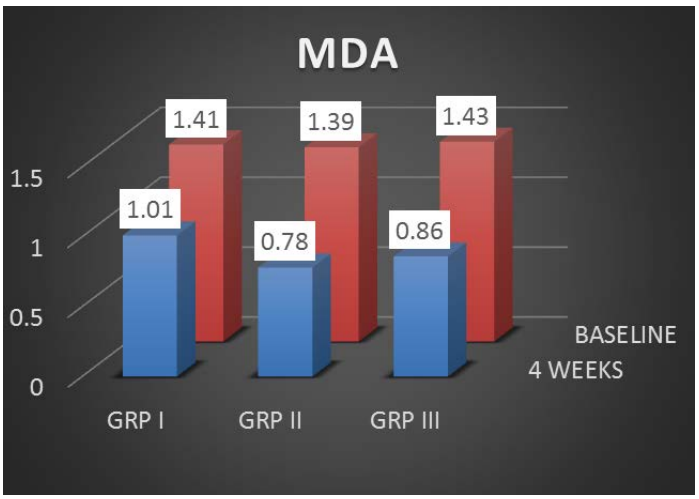
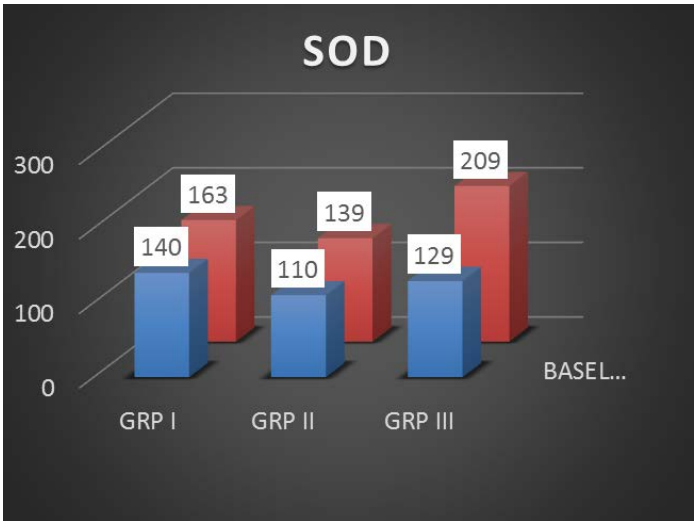


Figure 2: Mean Values of Sod at Baseline and 4 Weeks in All the Three Groups.



Discussion

ROS causes peroxidation of proteins, lipids, and DNA. MDA is one of the end products of lipid peroxidation whose levels are increased in periodontitis patients. The aim of this study was to evaluate the efficacy of melatonin and lycopene as an antioxidant in chronic periodontitis patients. There are very few studies regarding melatonin as an antioxidant in the literature while compared to lycopene.

It is well known that SRP remains a gold standard treatment for chronic periodontitis. [12,13] Some studies observed that there was an increase in oxidative stress markers such as MDA [14] in chronic periodontitis patients. Decrease in antioxidant enzymes such as superoxide dismutase,[15] glutathione peroxidase,[16] and total antioxidant capacity in chronic periodontitis patients has been observed and their levels improved following SRP.

Lycopene is considered as one of the most potent antioxidants. A study compared the effectiveness of lycopene as an adjunct to mechanical therapy with that of mechanical therapy alone in patients with mild to moderate periodontitis and moderate gingivitis and

showed that lycopene improved the periodontal status.[17] In this study, it was observed that the serum MDA levels as well as the SoD levels showed a significant improvement post treatment when chronic periodontitis patients were administered systemic lycopene for a period of 1 month which was in accordance with the findings of the study done by Ambati M et al. [18] Studies done by Chandra et al. [19] and Arora et al. [20] have shown that systemic lycopene supplementation was effective in gingivitis and periodontitis patients, for 2 months. A similar study reported that lycopene increased the total antioxidant capacity to MDA and enhanced serum IgM levels. [21]

The potential therapeutic effects of melatonin in periodontitis have been documented in vitro, as well as in animal studies and clinical trials. [22] Several research studies support the idea that melatonin could be used as a biomarker for monitoring the severity of periodontal disease, as well as a possible treatment strategy. [23,24]

In a study, subgroup analysis of lipid peroxidation and antioxidants level, showed study groups treated with vitamin E and melatonin showed a significant decrease in serum malondialdehyde (MDA) levels from baseline to post-treatment levels. [25] Similarly, in this study, it was observed that the serum MDA levels as well as the SoD levels showed a significant improvement post treatment when chronic periodontitis patients were administered systemic melatonin for a period of 1 month. There are quite a number of studies demonstrating the protective effect of melatonin on lipid peroxidation in different clinical settings.

when looking at the antioxidant properties of melatonin, it appears that it has a wide range of effects, including the reduction of the synthesis of proinflammatory cytokines and adhesion molecules. [26] A study reported that melatonin has no morphophysiological barriers and is readily available in cytosol; whereas vitamin E is primarily confined to the lipid membrane. [27] Thus, it is likely that melatonin is an effective antioxidant in the cytosol than vitamin E.

Within the limits of this study, melatonin might be a better antioxidant than lycopene but is inconclusive because of the smaller sample size and shorter study period. Further studies need to be done to study the dose dependent effect of melatonin.

Conclusion

Both lycopene and melatonin are potent antioxidants in patients with periodontitis which had a positive effect on biochemical parameters of periodontitis, conferring a new facet to the management of periodontitis and an attempt to impede the disease progression. Melatonin shows promise in the management of periodontal disease and elevated oxidative stress levels in periodontitis patients. It plays essential roles in modulating various immune responses and most of the studies have been favourable to usage of melatonin for therapy. However, more clinical trials and animal studies where melatonin is locally delivered to the target site are required to ascertain whether melatonin has potential as a therapeutic agent.

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