

Physiological challenging of stress in rats with zeaxanthin

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Abstract

This study was to rule whether the carotenoid zeaxanthin can withstand against the stress caused by hydrogen peroxide in rats. Three groups of twelve adult male Wistar rats were depended. The results hinted that zeaxanthin could significantly lower the elevated lipids LDL, TC, TAG, and VLDL caused by H₂O₂ and to elevate the HDL level. Besides, H₂O₂ caused a significant elevation in the serum anti-oxidant enzymes GPx, SOD, and CAT beside the stress marker MDA and when zeaxanthin was offered as a concomitant with H₂O₂, it caused a significant declination in these parameters.

Key words: Stress, Zeaxanthin, Lutein, Lipids, Antioxidant enzymes

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Introduction

As a part of the famous xanthophyll family, zeaxanthin stands in the front queue in a matiness with lutein. This unique compound is a carotenoid in its nature occurring in a vast spreading mode in vegetables particularly the green leafy ones beside the animal products like eggs and cheese [1, 2]. Human beings do not have the ability to constitute zeaxanthin and hence it is obligatory to obtain it from food resources [3].

The most body tissues in which zeaxanthin is accumulated is the macula of the retina [4]. The most important role of zeaxanthin in the body is that it is very essential to protect against what is known as the macular degeneration related to age and the eye cataract [5]. Besides, it is very potent protector against cardiovascular diseases [6]. Therefore, this study is to evaluate zeaxanthin ability to stand against stress or not.

Materials and Method**Animals of the Study**

Thirty-six adults male Wistar rats were housed in a standard cage under a very typical laboratory condition. After fourteen days acclimatization period, the animals were randomly

classified into three groups consisting of twelve rats to each. The weights of animals were 200-225 grams, and the period of experiment was one month.

Challenging groups

1. Control (C group). Animals feed on a standard diet.[7]
2. Stress (S group). Animals feed on a standard diet and drink water containing hydrogen peroxide, 0.1% H₂O₂. [8]
3. Stress and Zeaxanthin (SZ group). Animals feed on a standard diet and drink water containing 0.1% H₂O₂ concomitant with the use of oral gavage 2ml of distilled water containing 50 mg of zeaxanthin given daily. The rat oral LD50 of zeaxanthin is >2000 mg/kg BW.[9]

Blood sampling

When the experiment period has reached the end, blood samples were collected. The lateral tail vein was the target for obtaining blood. Following the method mentioned by [10], 1 ml of blood was collected from each rat to get the serum required for the tests.

Chemical Tests

1. Malondialdehyde (MDA). The biomarker of lipid peroxidation and oxidative stress.
2. Antioxidant enzymes; Superoxide Dismutase (SOD), Catalase (CAT) and Glutathione peroxidase (GPx).
3. Lipid profile; total cholesterol (TC), triacylglycerol (TAG), high density lipoprotein (HDL), low density lipoprotein (LDL), and very low-density lipoprotein (VLDL)

All the above-mentioned tests were done by a biochemical auto analyzer device (PKL, POKLER ITALIA).

Statistical analysis

ANOVA one way test was depended on to obtain the least significant differences among the groups at ($P \leq 0.05$). SPSS program version 20.

Results

As a stressor model, H₂O₂ caused a significant elevation in the total cholesterol (TC), triacylglycerols (TAG), low density lipoprotein (LDL) and very low-density lipoprotein (VLDL) with a significant declination in the high-density lipoprotein (HDL) of the stress group (S group) compared with the control group. Zeaxanthin was able to cause a significant declination for TC, TAG, LDL, and VLDL with a significant elevation for the HDL compared

with (S group) but the TC, TAG and LDL were still significantly higher than the (C group) and the HDL and VLDL were significantly lesser than the (C group), table 1.

Malondialdehyde (MDA) is the biomarker of oxidative stress. It is apparent in table 2, that H₂O₂ caused a significant elevation in MDA (S group) and zeaxanthin when offered with H₂O₂ caused a significant declination in MDA (SZ group) compared with (S group) to the limit it was with no significant difference compared with (C group). On other side, the antioxidant enzymes glutathione peroxidase (GPx), superoxide dismutase (SOD) and catalase (CAT) were significantly elevated in (S group) and the zeaxanthin significantly declined them but still higher than (C group).

Table 1.

Lipids profile

Groups	TC (mg/dl)	TAG (mg/dl)	HDL (mg/dl)	LDL (mg/dl)	VLDL (mg/dl)
C	72.2 ±2.05 ^c	54.4 ±3.9 ^c	40.3 ±2.1 ^a	21.1 ±2.8 ^c	12.3 ±1.4 ^b
S	90.1 ±6.5 ^a	71.9 ±3.3 ^a	21.8 ±2.4 ^c	55.5 ±8.0 ^a	15.8 ±0.9 ^a
SZ	80.05 ±3.8 ^b	61.3 ±2.6 ^b	34.8 ±3.4 ^b	31.7 ±6.1 ^b	11.4 ±1.5 ^c
LSD	7.85	6.9	5.5	10.6	0.9

Letters above numbers hint the significant differences. Numbers hint the means ± standard deviation. C=control group, S= stress group, SZ= stress and zeaxanthin group, LSD= least significant difference.

Table 2.

Stress marker and antioxidant enzymes

Groups	MDA ($\mu\text{m} / \text{L}$)	GPx ($\mu\text{m} / \text{L}$)	SOD ($\mu\text{m} / \text{L}$)	CAT (IU/ml)
	b	c	c	c
C	1.8 ± 0.4	77.3 ± 2.2	32.5 ± 1.5	2.1 ± 0.5
	a	a	a	a
S	6.3 ± 0.7	126.7 ± 2	81.2 ± 1.5	7.6 ± 0.7
	b	b	b	b
SZ	1.9 ± 0.3	83.4 ± 2.7	42.2 ± 1.1	3.2 ± 0.5
LSD	4.4	6.1	9.7	1.1

Letters above numbers hint the significant differences. Numbers hint the means \pm standard deviation. C=control group, S= stress group, SZ= stress and zeaxanthin group, LSD= least significant difference.

Discussion

Hydrogen peroxide (H_2O_2) is a globally depended experimental stress inducer. The most horrible effects of H_2O_2 on cells arise from its ability to generate free radicals. The most harmful form of H_2O_2 is the ($\text{OH}\cdot$), where this compound could cause serious damages to the cellular membranes as they are majorly composed of lipids, and it also causes DNA damages [11-13]. Oxidative stress is an upshot to the imbalance in the ability of the body to overcome stress when the stressors effect goes far the body ability and the upshot will be damage to the DNA, cell membranes and cause lipid peroxidation [14,15]. The most important marker of peroxidation status due to oxidative stress is the MDA which is resulted as a product of lipid peroxidation [16] and hence this could explain the significant elevation of MDA caused by H_2O_2 in our study findings.

This oxidative stress which is caused by H_2O_2 has led to sever inhibition in the formation of HDL and when the HDL decreases this will lead to high elevation in TC, TAG, LDL and VLDL because the major function of HDL is to transport cholesterol to the liver and to inhibit the peroxidation of LDL as it has a special ability to do that, so this will lead to the drastic elevations of lipids which was noticed in the findings [17, 18].

The increased status of stress and oxidation caused by H₂O₂ and was marked by increased MDA in our findings could explain the mechanism by which the anti-oxidant enzymes GPx, CAT and SOD were elevated after H₂O₂ intake by rats. Where, many researchers linked these abrupt elevations of anti-oxidant enzymes to the oxidative stress status.[23-19]

The declination in lipids and the anti-oxidant enzymes which was caused by zeaxanthin when it was offered as concomitant with H₂O₂, in other words the improvement in all these parameters is due to the very potent effect of zeaxanthin as a carotenoid to perform that. Many researchers have reported that carotenoids including the zeaxanthin have a potent antioxidant capabilities which render them a very important protectors against oxidative damages caused by free radicals, hence protecting the body different organs and systems against these harmful annihilating effects, where zeaxanthin was found to be a protective against cataract of eye, cardiovascular diseases, skin diseases, renal and hepatic diseases beside many others due to its ability to protect against oxidative stress.[27-24]

Conclusions

It is obvious depending upon the results that zeaxanthin is a stress fighter, and it might be used as a food complement to lower serum lipids and protect against stress consequences.

Conflicts of Interest

The author declare that he has no competing interests.

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