

Reactive oxygen species

Can ocular nutritional supplements help?

Frank Eperjesi discusses the effects of reactive oxygen species on the retina and the effects of vitamins, carotenoids and zinc on retinal oxidation. This is followed by a brief overview of six ocular nutritional supplements commonly available in the UK.

In the metabolically active, oxygen rich environment of the retina, short wavelength radiation initiates the production of active, damaging forms of oxygen known as reactive oxygen species (ROS). These substances are by-products of normal cellular metabolism and the photochemical reactions which occur in the retina. ROS include free radicals, which can be described as atoms or molecules containing one or more unpaired electrons, e.g. superoxide anions and hydroxyl radicals. The term ROS can be applied to other substances such as atoms or molecules with a full complement of electrons in an unstable or reactive state, e.g. singlet oxygen and hydrogen peroxide.

Metabolic and light generation of ROS leads to peroxidation of membrane lipids and cellular damage (especially to rod outer segments) at the RPE-photoreceptor level. Photoreceptor phospholipids donate an electron to stabilise free radicals but become oxidised and damaged in the process. Age-related lipid protein by-products of ROS oxidative damage to photoreceptors are known as lipofuscin, a complex of non-degradable polymers of oxidised lipids and protein residues.

Figure 1 shows a summary of oxidative stress.

Mechanisms for the prevention of oxidation and removal of metabolic waste do exist – for example, vitamins A, C, E,

carotenoids and the RPE complex – but most are compromised with age, smoking, poor diet and alcohol consumption.

Vitamins

Vitamins A, C and E are micronutrients with inherent antioxidant properties, and neutralise ROS without forming toxic substances. Vitamin A reduces the effects of ROS on photoreceptors. Vitamin C also has a role in protecting against ROS mediated oxidative tissue damage. Vitamin E is found in high concentrations within the retina and is required to remove cellular debris produced in the phagocytosis process. Plasma concentration of vitamins reduces with age. Observational and epidemiological studies suggest that subjects with a high intake of antioxidants have a decreased risk of developing AMD.

Carotenoids

Lutein and zeaxanthin are pigments which occur naturally in the macula. They are entirely of dietary origin and considered to play an important role in the biomedical protection of the macula by absorbing short wavelength light and neutralising ROS. The general consensus is that most people need at least 6mg of lutein per day while the 'average Western diet' provides only between 1.5mg and 3mg per day.

Zinc

Zinc is highly concentrated in ocular tissues, particularly the retina and pigment epithelium. It acts as a co-factor for the antioxidant enzymes retinal dehydrogenase and catalase and is also involved in retinal metabolism.

Ocular nutritional supplements

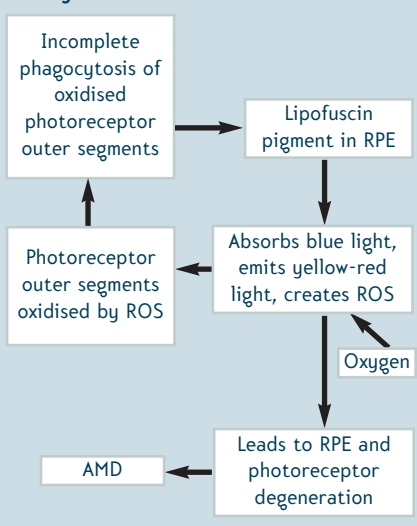
ICaps®

ICaps (Alcon Laboratories) could be useful to a person with early AMD (a few hard and soft drusen). It could also be useful for those deemed at risk of developing AMD, for example, those with a family history of the disease or who have a few hard drusen present. ICaps has proven bioavailability in a sustained release formula.

The contents of ICaps are shown in Table 1.



Figure 1 Oxidative stress



Ocuvite® PreserVision™ and Ocuvite® Lutein

Ocuvite® PreserVision™ (Bausch & Lomb) is a high potency formulation which has been shown to reduce the progression of AMD associated with extensive, intermediate sized drusen, one large drusen, non-central geographic atrophy in one or both eyes, or advanced AMD. It is contraindicated for smokers.

Table 2 shows the ingredients of Ocuvite PreserVision.

As with ICaps, Ocuvite Lutein (Bausch & Lomb) could be useful to a person with early AMD (a few hard and soft drusen) or at risk of developing AMD – especially if they have a low lutein diet. It contains 6mg of lutein per tablet as well as vitamins C and E plus zinc and copper and will be available in the UK shortly.

Table 3 shows the ingredients of Ocuvite Lutein.

Retinex Eye Nutrient

Vitamins and minerals supplements may be contraindicated for people with some illnesses, for example insulin-dependent diabetes. A supplement such as Retinex (Healthspan), which contains only lutein (10mg) and zeaxanthin (440mcg) per tablet (Table 4), is very likely to be suitable for this type of person since these carotenoids have no known adverse reactions. However, for these patients it would be wise to include the GP in the decision-making process.

Quest Eye Nutrient Complex

As with ICaps and Ocuvite Lutein, Quest Eye Nutrient Complex (Quest Vitamins) could be useful to a person with early AMD or at risk of developing it. See Table 5.

Visionace®

Visionace (Vitabiotics) can be thought of as an ocular nutritional supplement combined with a systemic nutritional supplement. It therefore may be useful for those people who are at risk of ocular disease and who have a poor diet. See Table 6.

In those instances where a patient is interested in using ocular nutritional supplements, but is already taking high doses of general nutritional supplements or using insulin or anti-coagulant medication, then a consultation with their GP is recommended.

About the author

Dr Frank Eperjesi is a lecturer in the Division of Optometry at Aston University. This article is based on a presentation by him at Optometry 03 in Birmingham last April.

Table 1

Nutritional value of ICaps supplements (daily dose = two tablets)

Nutrient	Daily intake	%EC RDA
Vitamin A	666mcg	84%
(as beta-carotene)	4mg	N/A
Vitamin E	150mg	1500%
Vitamin C	400mg	666%
Riboflavin (vitamin B2)	10mg	624%
Zinc (as zinc acetate)	60mg	400%
Selenium	40mcg	N/A
Copper	4mg	N/A
Manganese	10mg	N/A
Lutein/zeaxanthin	4mg	N/A

Sustained release formula for improved absorption.

Contains zinc as acetate for improved tolerability.

Table 2

Nutritional value of Ocuvite PreserVision supplement (daily dose = four tablets)

Nutrient	Daily intake	%EC RDA
Beta-carotene	17.2mg	N/A
Providing:		
Vitamin A	2864ug	358%
Vitamin C	452mg	753%
Vitamin E	268mg	2680%
Zinc (zinc oxide)	69.6mg	464%
Copper	1.6mg	N/A

Table 3

Nutritional value of Ocuvite Lutein supplement (daily dose = one tablet)

Nutrient	Daily intake	%EC RDA
Lutein	6mg	N/A
Zinc	15mg	100%
Copper	2mg	100%
Vitamin C	60mg	100%
Vitamin E	30IU	100%

Table 4

Nutritional value of Retinex supplement (daily dose = one to two tablets)

Nutrient	Daily intake
Lutein	10-20mg
Zeaxanthin	440-480mcg

Contains – lutein, maltodextrin, dicalcium phosphate dihydrate, microcrystalline cellulose, opadry II orange, silica, stearic acid, sodium croscarmellose, magnesium stearate (vegetable origin).

Table 5

Nutritional value of Quest Eye Nutrient Complex (daily dose = one tablet)

Nutrient	Daily intake	%EC RDA
Vitamin A	750ug	94%
Vitamin C	250mg	417%
Vitamin E (50iu)	34mg	340%
Zinc	10mg	67%
Copper	0.5mg	N/A
Lutein	6mg	N/A

Contains variable amounts of zeaxanthin and other carotenoids.

Contains zinc and copper as amino acid chelate.

Table 6

Nutritional value of Visionace supplements (daily dose = one tablet)

Nutrient	Daily intake	%EC RDA
Vitamin A (1000IU)	300mcg	38%
Vitamin D (100IU)	2.5mcg	50%
Vitamin E (natural source)	60mg	600%
Vitamin C	150mg	250%
Vitamin B1 (thiamin)	12mg	857%
Vitamin B2 (riboflavin)	4.8mg	300%
Vitamin B3 (niacin)	18mg	100%
Vitamin B6	10mg	500%
Folacin (as folic acid)	400mcg	200%
Vitamin B12	9mcg	900%
Pantothenic acid	20mg	332%
Iron	6mg	42%
Magnesium	50mg	16%
Zinc	15mg	100%
Iodine	100mcg	66%
Copper	1mg	N/A
Manganese	4mg	N/A
Selenium	150mcg	N/A
Chromium	50mcg	N/A
Natural mixed carotenoids	3mg	N/A
Citrus bioflavonoids	15mg	N/A
Bilberry extract equivalent to	60mg	N/A
Lutein esters	4mg	N/A

Useful websites

www.icapsinfo.co.uk
www.bausch.com
www.healthspan.gg
www.questvitamins.co.uk
www.visionace.com