

Nutritional advice for patients suffering from cataracts, dry macular degeneration and 'dry eyes'

The health of the eyes is constantly under threat from oxidative damage by “free radicals” (chemically unstable molecules which react with proteins and lipids, causing their degradation). In part these are generated by normal metabolic processes, but also by exposure to sunlight (UV), atmospheric pollution and cigarette smoke, all of which cause the tissues of the eye to age. Our built-in repair mechanisms that fight such damage become progressively less effective as we get older and for a significant minority, this can lead to degenerative eye conditions, including age related macular degeneration (ARMD), cataracts and xerophthalmia ('dry eye').

***ARMD** – Progressive loss of central vision caused by the death or impairment of the cells in the macula (the centre part of the retina responsible for detailed vision).*

***Cataract** – Loss of transparency of the crystalline lens, almost as if a 'skin' has grown across the eye.*

***Dry Eye** – interaction of an abnormal tear film and/or abnormal ocular surface.*

Scientific research has now established that good nutrition can help guard against the development of such conditions<sup>1</sup>. There are a number of nutrients which are only required in relatively small amounts, but are **essential** for good health.

**Macronutrients** include carbohydrates, proteins, fats, macro-minerals, and water. All foods are classified as being either fat, protein or carbohydrate. The optimal human diet should consist of 70% carbohydrate, 15% fat, and 15% protein. Unfortunately, this balance is not reflected in the typical modern diet in the UK, which averages around 48% carbohydrate (20% of which is *pure* sugar), 40% fat and 12% protein<sup>2</sup>. **Micronutrients** are vitamins and trace minerals, labelled as such because the body only requires them in very small amounts to maintain cellular structure.

More than 25% of available nutrients in the body contribute towards nourishing the eye, and the nerves, blood vessels and tissues which support visual function. These nutrients do not work in isolation, but *synergistically*, i.e. they are co-dependent – a broad base of vitamins and antioxidants is required to maintain eye health<sup>3</sup>. There are however, certain vitamins and minerals that may benefit specific conditions:

### ARMD

**Carotenoids** – Help to protect plants from sunlight, and work in a similar way in our bodies, in the form of powerful antioxidants such as lutein, zeaxanthin and lycopene (L&Z), which neutralise free radicals. L&Zs are the only carotenoids found in the lens and retina of the eye. They form the macular pigment, a protective layer that absorbs blue light – the most damaging to the retinal receptors and retinal pigment epithelium. People with a lower density of macular pigment are believed to be at a greater risk of ARMD<sup>1</sup>.

**Vitamin A** (Retinol) – Is required for the formation of rhodopsin, the visual pigment of the low light density photoreceptor cells – the 'rods'.

**Zinc** – Plays an important role in the metabolism of the retina, which contains one of the highest concentrations of zinc in the body, emphasising its significance to the visual pigments. Zinc ions are present in the enzyme ‘superoxide dismutase’, which plays an important role in disarming free radicals.

**Vitamin E** – Damage to the retina has been detected during vitamin E deficiency<sup>1</sup>. It plays a role in the maintenance of cell membrane integrity, as it is the major lipid soluble antioxidant of retinal membranes and has anti-inflammatory properties.

### Cataracts

**Vitamin C** – High levels are present in the aqueous humour which is believed to act as an UV filter. This helps to protect the lens against cataracts, and oxidative damage to the retina and lens, by inactivating superoxide molecules generated during light exposure of the macula<sup>2</sup>.

**Vitamin B<sub>2</sub>** (Riboflavin) – Low riboflavin intake has been shown to be associated with an increased risk of cataracts<sup>4,5</sup>.

**Carotenoids** – See AMRD.

**Flavonoids / Bioflavonoids** – Support the action of vitamin C in maintaining the integrity of the blood capillaries and contribute to the antioxidant status of cells<sup>6</sup>. Quercetin in particular has been shown to delay cataract formation in animals<sup>7</sup>.

**Selenium** – Is an integral part of the antioxidant enzyme ‘glutathione peroxidase’, which has been shown to help prevent the formation of cataracts and protect other eye tissues<sup>8</sup>, by destroying lipid peroxides and so repairing oxidised lipids.

**Chromium** – Levels are much lower in the lenses of people with cataracts<sup>9</sup>.

**Glutathione** – Is very highly concentrated in the lens, where it acts as an antioxidant and is a key protective factor against intra- and extralenticular toxins. It is found to be very low in virtually all cases of cataract<sup>2</sup>.

### ‘Dry eye’ syndrome

**Essential Fatty Acids** (EFAs) – Omega 3 and Omega 6. The ideal ratio of these two EFAs is considered to be no higher than 4:1 of omega-6 to omega-3, but modern Western diets have a much higher ratio than this, sometimes as high as 30:1. There is evidence that a higher ratio is associated with dry eye syndrome<sup>10</sup>.

Similarly, evening primrose oil has been indicated as having a beneficial effect on those suffering from dry eyes<sup>7</sup>.

A handy overview of this information can be found at Diagram 1.

In light of the supporting evidence, it is logical to consider enhancing the antioxidant status of the eye by nutritional means in order to promote eye health and prevent such degenerative eye conditions. Some good dietary sources of the nutrients discussed can be found in the Table<sup>10</sup> below.

Nutrient	RNI (mg)		Some good dietary sources	Max. daily intake (mg)
	Men	Women		
Vitamin A	0.7	0.6	Liver, dairy products	1.5
$\beta$ -carotene	-	-	Spinach, carrots, red peppers, mango	7
L&Z	-	-	Spinach, kale, lettuce, peas	-
Vitamin B <sub>1</sub>	1-1.4	1-0.8	Wholegrain cereals, meat, dairy products, fruit, vegetables	100
Vitamin B <sub>2</sub>	1.3	1.1	Milk, eggs, fortified cereals	40
Vitamin B <sub>3</sub>	17	13	Meat, dairy products	17 (Nicotinic acid) 500 (Nicotinamide)
Vitamin B <sub>6</sub>	1.4	1.2	Chicken, wholegrain cereals, eggs, nuts	10
Vitamin B <sub>9</sub>	0.2	0.2	Liver, green leafy vegetables	1
Vitamin B <sub>12</sub>	0.0015	0.0015	Meat, fish, dairy products	2
Vitamin C	40	40	Citrus fruit, strawberries, green leafy vegetables, liver, kidney	1000
Vitamin E	4	3	Vegetable oils	540
Selenium	0.075	0.06	Seafood, liver, brazil nuts	0.35
Zinc	5.5-9.5	4-7	Red meat, cereals, dairy products, shellfish	25

(N.B. The best source of Omega 3 & 6 is oily fish, such as mackerel and salmon.)

A varied and balanced diet should supply adequate quantities of the aforementioned nutrients, but many people choose to take supplements. However, as can be seen in the Table above, current UK guidelines indicate a daily intake required to maintain good health, known as the Reference Nutrient Intake (RNI). The maximum intake is the quantity that it is considered safe to consume per day without toxic effects occurring under normal circumstances<sup>10</sup>.

- ☹️ For example, a recent study suggested that high  $\beta$ -carotene (preformed vitamin A) intake is associated with an **increased** risk of ARMD<sup>10</sup>.
- ☹️ High doses of vitamin A have also been linked to an increased risk of lung cancer. Patients suffering with ARMD that are smokers should use an alternative supplement formulation in which vitamin A has been replaced by lutein<sup>10</sup>.
- ☹️ Patients suffering from ARMD and taking a zinc supplement, should be aware that this may depress copper levels (which is also an important component of the enzyme superoxide dismutase) and hence some copper should also be taken with a zinc supplement<sup>7</sup>.
- ☹️ Alcohol can be a factor in the body's ability to absorb certain vitamins. For example, the various vitamins in the B complex are present in many foods and deficiency in a normal diet is rare, but absorption by the digestive system of B<sub>1</sub> and B<sub>12</sub> in particular is easily disrupted by alcohol<sup>10</sup>.
- ☹️ Pre-existing medical conditions may also be of concern, for instance vitamin E is readily available in a normal diet and hence deficiency is rare, but may

occur in patients with digestive problems who are unable to absorb dietary fats<sup>10</sup>.

In view of their relative low cost and low toxicity, supplements offer potentially enormous benefits for people with degenerative eye diseases. However, there seems to be no specific legal guidance for the recommendation of nutritional supplements, they are **not** for instance referenced in the Medicines Act 1968 – most are on the General Sales List (GSL) and hence available without prescription. Nevertheless, it should always be remembered that some vitamins and minerals **are** toxic if taken in excess, therefore it is perhaps unwise for inexperienced Receptionists or Optical Assistants to proffer advice. Although perhaps better left to the Ophthalmologist who, at entry level 1 is accredited for ‘therapeutic prescribing’ (according to legislation passed in June 2005), should a Dispensing Optician be required to assist a patient who wishes to purchase a supplement, there are some general principles which may be applied to help them choose: -

- ✔ Care should always be taken when making recommendations to infants and children, the elderly, and women that are pregnant or lactating, as they have different requirements.
- ✔ The patient should always be advised to consult their GP before making changes to their diet or starting to take supplements. This is particularly important for the elderly, for those considering a daily dose significantly higher than the RNI, and for patients taking other medication.
- ✔ The biggest avoidable risk is smoking, but as mentioned previously, should smokers wish to take nutritional supplements, they should opt for those where vitamin A has been replaced by lutein.
- ✔ When making a choice, the patient should look for a comprehensive formula, which has been **clinically tested**. It should contain the key ingredients lutein and zinc and a range of other important vitamins, minerals and antioxidants such as those discussed throughout this report.

#### Other conditions that may benefit from nutritional advice

**Conjunctivitis sicca** (Particularly in those with Sjögren’s syndrome) – Has been shown to benefit from an evening primrose oil supplement<sup>7</sup>.

**Diabetic retinopathy** – Decreased levels of selenium in the aqueous humour have been linked to this disorder<sup>2</sup>.

**Glaucoma** – One study found that subjects with low tension glaucoma have shown a reduction in field loss after taking a supplement of Ginkgo Biloba. However, Ginkgo should **NOT** be taken in combination with anticoagulants such as aspirin or warfarin<sup>11</sup>.

**Optic nerve dysfunction** – The B vitamins, in particular B<sub>1</sub>, and including folic acid, are essential for protein synthesis and are associated with the health of the optic nerve. A deficiency can lead to disturbance of eye tracking and optic nerve dysfunction<sup>1</sup>.

**Night blindness** has been associated with a lack of vitamin A<sup>2</sup>.

**Nutritional amblyopia** has been linked to a deficiency in thiamine (B<sub>1</sub>), niacin (B<sub>3</sub>), folic acid (B<sub>9</sub>) or cyanocobalamin (B<sub>12</sub>), or a combination<sup>10</sup>.

**Retinal vein occlusion** – The role of antioxidant vitamins and carotenoids in protecting the circulation of the body as a whole is well recognised, and hence may be linked to the prevention of such retinal vascular disorders<sup>7</sup>.

**Retinitis pigmentosa** – Supplementation with vitamin A has been shown to slow the degeneration of rods, and is being used to help treat this degenerative eye disease<sup>12</sup>.

In conclusion, evidence regarding the benefits of nutritional supplements against eye disease **is** conflicting, and there is no real agreement among researchers on the subject at present. However, a consensus **has** been reached on the importance of a healthy, balanced diet full of fresh fruits, vegetables and oily fish.

Bibliography

1. Anonymous (n.d.) *Nutrition and the Eye*. Retrieved August 24<sup>th</sup>, 2009, from [www.maculardisease.org](http://www.maculardisease.org).
2. Davies, M. *Nutrition and the eye: An introduction Part 1*. OT (January 16 2004).
3. Davies, M. *Nutrition and the eye: An introduction Part 2*. OT (February 13 2004).
4. R.D. Sperduto, et al. (1993). *The Linxian cataract studies. Two nutrition intervention trials*. Arch Ophthalmol. Sep; 111(9): 1246-53.
5. B.R. Straatsma, et al. (1991). *Lens capsule and epithelium in age-related cataract*. Am J Ophthalmol. Sep; 15; 112(3): 283-96.
6. Ueda T et al. (1996). *Preventive effect of natural and synthetic antioxidants on lipid peroxidation in the mammalian eye*. Ophthalmic Research. 28: 184-192.
7. Phelps Brown, N. *Nutrition and the eye: Nutrition in cataract and retinal conditions*. OT (April 9 2004).
8. Spector, A. et al. (1993). *The prevention of cataract caused by oxidative stress in cultured rat lenses. LH202 and photochemically induced cataract*. Curr Eye Res. Feb; 12(2): 163-79.
9. A. Pineau, et al. (1992). *A study of chromium in human cataractous lenses and whole blood of diabetics, senile, and normal population*. Biol Trace Elem Res Jan-Mar; 32: 133-8.
10. Rapley, L. *Dietary supplements for the eyes*. Dispensing Optics (March 2009).
11. Quaranta, L., Bettelli S., Uva, M. G., Semeraro, F., Turano, R., Gandolfo, E. (2003). *Effect of Ginkgo biloba extract on pre-existing visual field damage in normal tension glaucoma*. Ophthalmology 110 (2): 359-62.
12. Berson et al. (1993). *A randomized trial of Vitamin A and Vitamin E supplementation for retinitis pigmentosa*. Arch Ophthalmol. Jun; 111 (6): 761-762.