Astaxanthin - a possible ocular antioxidant?

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Nutraceuticals and supplements

- To address dietary deficiencies (e.g. calcium, iron, magnesium, zinc)
- For dietary top-up/insurance policy
- Improve cognition (reduce depression)
- Slow down ageing
- Health-conscious (e.g. exercise)
- Adjuvant to improve bioavailability
- Pet food (e.g. Radical Dog Biscuits!)

USA usage: 76% in 2018 (vs 64% in 2008)

Very profitable multi-billion dollar industry; unregulated & under-researched in many areas

Different groups

- Vitamins & minerals
- Herbs/extracts/plant & berry extracts, amino acids, enzymes
- FDA: “common ones”
  - “Should not make disease claims”
  - “lowers cholesterol”
- Warns about overdosing, combining & substituting for Rx medicines
- “Oxidative tissue damage” = ageing & disease

“As we age, prooxidants overwhelm the eye’s antioxidant defence resulting in oxidative stress. This results in the development of ocular pathologies such as cataracts, glaucoma”

(Umapathy A, Donaldson P & Lim J, 2013)

General eye health nutrition

- Calcium
- Echinacea
- Fish Oil
- Ginseng
- Glucosamine and/or Chondroitin Sulphate
- Garlic
- Vitamin D
- St. John’s Wort
- Saw Palmetto
- Ginkgo
- Green Tea

Astaxanthin (ATX)

- Common marine xanthophyll carotenoid (main source marine algae H. pluvialis)
- Closely related to human retinal pigments lutein & zeaxanthin
- Strongest antioxidant (AO) activity of all the carotenoids
- Lipid soluble - so good absorption across cell membranes
- Can cross blood-retina and blood-brain barrier (Tan, 1996)
**Haematococcus pluvialis**

- Freshwater green marine algae, can be farmed
- Encysts & produces ATX as a protector against stress conditions such as UV light, high salinity, low nutrient availability & high temperature
- High bioavailability from dual lipophilic and hydrophilic properties across CMs
- AO activity of ATX:
  - 10 x zeaxanthin, lutein & B-carotene
  - 500 x Vit A

Also has immunomodulation & anti-inflammatory properties—reduces C-RP, boosts NK, T & B-cells, cytokines

**Existing products**

**ATX and the eye- existing study data and potential investigations?**

- **Dry eye disease:** krill oil phospholipid containing AXT > fish oil less inflammatory markers
- **Sjogren’s?:** helps salivary gland (but no studies on lacrimal gland)
- **Aqueous humour:** has increased superoxide scavenging activity so potential less TM degeneration
- **Retina:** AMD, DR and glaucoma?
- **RPE /photoreceptor damage/ageing**

**Existing researched benefits (humans)**

- Exercise recovery
- Reduced joint inflammation
- Improved mitochondrial function
- Skin protection (UV)
- Anti-diabetic
- Immunomodulation
- Neuro-protection
- Cardiovascular disease
- Anti-cancer

**MURINE STUDIES:** induced elevated IOPs, diabetic retinopathy, photostress

- **% of population- people aged 90 or over:**
  - 1980- 2.8%
  - 2020- 4.7%
  - 2050- 10% est.
So do we need another carotenoid?

- The AREDS2 formula works best if poorer diet; risk of advanced AMD was lowered by about 20%
- Could the AREDS2 formula be due for a review?
- Can non-invasively measure the macular carotenoid pigment optical density (MPOD)

Other interesting compounds

- Saffron, tumeric & chamomile
- Blueberry & goji berry
- All potent antioxidants and anti-inflammatories; similar list of alleged benefits to ATX
- Plenty of PubMed published studies on retinal protection

Crystal ball gazing...

- I think that over the next 5-10 years there is going to be a surge of research attempting to legitimise some of these promising natural products
- We have to persuade some of these producers to fund proper research— even 1 Masters/PhD is great “value for money”...