Formulating with AstaReal® Astaxanthin

October 2018
Today’s Agenda

• AstaReal
  – Quality, What Makes us Different
• Innovation Opportunities
  – Clinical Platforms & Concepts
• Discussion
Who is AstaReal?

Founded in 1946, Fuji Chemical Industries Co., Ltd is a manufacturer of pharmaceutical ingredients.
AstaReal is a Global Brand

Natural Astaxanthin Production Facilities in Moses Lake, WA USA & Gustavsberg, Sweden

Pioneer in commercial astaxanthin production:

- Launched AstaReal® Astaxanthin brand in 1995
- Built natural astaxanthin market
- Astaxanthin experts
- Unrivaled technical and marketing support
- Over 30 years of Global presence
- Sold in over 50 countries
The Astaxanthin Gold Standard

- Proprietary Manufacturing Process
  - Unique closed indoor cultivation
    - HEPA filtered air
    - Purified RO water
  - Uninterrupted supply assurance
  - Consistent Potency; >4.5% every batch
  - High stability
  - Made in the USA

- Science Based Nutrition
  - Most clinically studied astaxanthin brand worldwide
  - Category leader with R&D investment
The Most Studied Astaxanthin Brand

Astaxanthin Pioneer with more than 150 published AstaReal® studies since 1980’s and more than 60 published AstaReal® human clinical studies

- 12 published AstaReal® human studies
- 2 new AstaReal studies coming soon...

- 16 published AstaReal® human studies
- Computer Vision Syndrome astaxanthin data exclusive to AstaReal

- 6 published AstaReal® human studies

- 4 published AstaReal® human studies

- 13 published AstaReal® human studies

- Investment in research & innovation
- Expanding health platforms
Not All Astaxanthin is the Same

Type of cultivation system contributes to quality of products.
Indoor Closed System

- Perfectly closed system that use artificial lights
- Highly Controllability
- High Biomass/High Carotenoids Content
- Low Contamination Risk
- Reproducibility(H), Quality(H), Productivity(H), Cost(M-H)
AstaReal® - Unrivaled Cultivation Expertise

AstaReal Proprietary Indoor Manufacturing Process

Haematococcus pluvialis

GREEN PHASE  INTERMEDIATE  RED PHASE
Outdoor Closed System

- Outdoor Closed System that use natural sunlight
- Low Controllability (by Weather)
- Middle-High Biomass / High Carotenoids Content
- Middle-Contamination Risk (vs. Open Pond System)
- Reproducibility(M), Quality(M-H), Productivity(M), Cost(M-H)
Commercial Production of AX by *Haematococcus* Algae

**Raceway Open Pond**

- Most Classical Technology for Commercial Mass Algal Cultivation
- Open Outdoor Space, Natural Sunlight
- Partially Combined with Closed System for Green Stage
- Low Biomass/Low Carotenoids Content
- High Contamination Risk
- Reproducibility(L), Quality(L), Productivity(L), Cost(L)

**Highest Risk of Contamination**

Company C
AstaReal® - Unrivaled Cultivation Expertise

AstaReal® Fully Matured Red Phase

Company B Incomplete Red Phase

Red=Astaxanthin

Green=Chlorophyll
AstaReal® indoor closed system provides FULL process control which results in little or no impurities.

Competitive Analysis Uncovers Impurities

Company B

Company C

Chlorophyll derivatives

Pheophorbide
The symptoms are erythema, pain and itch, and dropsy by dermatitis.
## Competitive Analysis of Pheophorbides

<table>
<thead>
<tr>
<th>Production year</th>
<th>Result (mg%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018-1</td>
<td>N.D (LOQ 5mg%)</td>
</tr>
<tr>
<td>2018-2</td>
<td>6</td>
</tr>
<tr>
<td>2018-3</td>
<td>5</td>
</tr>
<tr>
<td>2017-1</td>
<td>66</td>
</tr>
<tr>
<td>2017-2</td>
<td>46</td>
</tr>
<tr>
<td>2017-3</td>
<td>50</td>
</tr>
<tr>
<td>2017-4</td>
<td>50</td>
</tr>
<tr>
<td>2016</td>
<td>38</td>
</tr>
<tr>
<td>2017</td>
<td>58</td>
</tr>
</tbody>
</table>

**Company B**

**Company C**

USP Specification: <0.02% (20mg%)

Company B & C are beyond the criterion of USP

- **Risk of photosensivity in skin; which could be safety concern**
AstaReal® Astaxanthin Quality Helps Ensure High Stability

ACCELERATED STABILITY TEST
In 80°C in presence of saturated oxygen

- AstaReal®
- Company A
- Company B
- Company C
- Company D

Retention (%) vs. Time (h)
AstaReal® Astaxanthin Powders

**P2AF**: 2% astaxanthin powder  
**P4AF**: 4% astaxanthin powder  
**P25HB**: 2.5% astaxanthin powder  
**CWS25**: 2.5% cold water soluble astaxanthin powder

**Powder Applications**: tablets, capsules, chews, baked goods, protein bars (if water soluble ingredients)

**CWS Applications**: chews, capsules, serum, cream (maybe if water based ingredients), gummies, hard candy, baked goods, effervescent tablets, instant drinks, protein bars (if water soluble ingredients)
AstaReal® Astaxanthin Oil – 100% Made in the USA

L5 oil: 5% astaxanthin
L10 oil: 10% astaxanthin

Applications: softgels, li-cap, creams, gummies, hard candy, baked goods, protein bars (if fat soluble ingredients)

Unrivaled Certifications

AstaReal® L10 and CWS25
The First & Only Astaxanthin Certified Ingredients by Informed-Choice & Informed-Sport
Innovation Opportunities

Leveraging AstaReal® Science

September 2018
Innovation - Partnering for Success

AstaReal® for Skin & Beauty 2-6 mg/day
AstaReal® for Joint/Muscle Endurance & Recovery 4-6 mg/day
AstaReal® for Healthy Eyes 4-6 mg/day
AstaReal® for Brain Health 2, 6-12 mg/day
AstaReal® for Heart 2, 6-12 mg/day

Key Take Away
AstaReal, Astaxanthin Pioneer with more than 60 published clinical studies.
AstaReal® for Joint and Muscle Endurance & Recovery

AstaReal® for Joint/ Muscle Endurance & Recovery
4-6 mg/day
Suggested Structure Function Claims for Muscle Health

• Reduce build up of lactic acid\textsuperscript{1,12}
• Supports endurance and muscle performance\textsuperscript{2,3}
• Supports sustained energy and athletic performance\textsuperscript{2,3}
• Helps improve power output\textsuperscript{3}
• Supports muscle recovery\textsuperscript{4, 5, 6}
• Protect against exercise-induced muscle damage\textsuperscript{4, 5, 6}
• Promotes good circulation – nutrition and oxygenation of muscles\textsuperscript{7, 8, 9}
• Promotes mental clarity and focus\textsuperscript{10}

Studies with \textbf{ASTAREAL® Astaxanthin}

Astaxanthin Protects the Mitochondria from Damage

- Muscle tissue is rich in mitochondria, which is essential to help meet body’s energy demands.
- The ‘Mighty Mitochondria’ is where energy is produced & it uses fat as its energy source.
- Harmful free radicals are created as the body creates energy.
- Build up of free radicals can damage the mitochondria forcing its energy production outside it.

Key Take Away:
Astaxanthin acts as a shield and protects the mitochondria from damage keeping energy production inside the mitochondria instead of outside.
How Astaxanthin Works in Muscle for Endurance

✓ Once energy production is outside the mitochondria, sugar is used instead of fat and this process causes lactic acid
✓ Build up of lactic acid can cause cramping and soreness
✓ By keeping energy production inside the mitochondria, you can maximize energy output thus better endurance.
✓ Because it protects the mitochondria, Astaxanthin helps boost energy efficiency as it promotes use of fat as an energy source

The Mighty Mitochondria

Did you know?
1g fat can produce 6X more energy compared to 1g of sugar.

AstaReal® Astaxanthin shields mitochondria from damage by neutralizing free radicals
How Astaxanthin Works in Muscle - Recovery

Exercise causes muscles to break down and after exercise they need repaired.

White blood cells job is to repair our muscles after exercise but in doing so they cause harmful free radicals.

Free radicals cause inflammation and soreness.

Astaxanthin protects our muscle from free radical damage and thus helps minimize exercise-induced inflammation and soreness.
Astaxanthin Improves Muscle Function - Summary

Lactic Acid Cycle

Symptoms related to endurance

- The energy sources shortage (limited blood glucose and liver glycogen)
- Blood vessels, if damaged or not resilient, cannot deliver adequate oxygen or nutrients to your muscles
- Generate harmful ROS when Mitochondria produces adenosine triphosphate (ATP)
- ROS oxidizes membrane and fat

Astaxanthin’s efficacy

1. Fat burning
   - Astaxanthin facilitates the use of fat as energy source

2. Improve blood quality/flow
   - Astaxanthin increase vascular resistance or blood flow

3. Anti-oxidation
   - Protect membrane or fat from ROS
   - Facilitate fast recovery
1. Astaxanthin improves muscle performance, endurance, and recovery to build muscles able to support joint function.
2. Astaxanthin alleviates perceived muscle and joint pain.
3. Astaxanthin reduces inflammation that can damage joints.
4. Astaxanthin improves circulation, bringing nutrients and oxygen to promote the maintenance of healthy joints.
AstaReal® for Beauty
2-6 mg/day
How Astaxanthin Helps Protect & Support Skin

- Antioxidant protection
- Resilience against inflammation
- Cell restoration
- Nourishing blood flow

*Fibroblasts: Cells that make up the dermis and produce collagen and hyaluronic acid.*
Suggested Skin Structure/Function claims*:

- AstaReal® Astaxanthin supports skin hydration \(^1,\(^2,\(^3\)
- AstaReal® Astaxanthin improves skin texture \(^3\)
- AstaReal® Astaxanthin promotes smooth skin \(^3\)
- AstaReal® Astaxanthin enhances skin elasticity \(^3\)
- AstaReal® Astaxanthin reduces skin spots \(^1\)
- AstaReal® Astaxanthin promotes even skin tone [erythema/redness] \(^3\)

Suggested Skin Structure/Function Claims at 6 mg/day

Suggested Skin Structure/Function claims*:

- AstaReal® Astaxanthin supports skin hydration ¹, ²,
- AstaReal® Astaxanthin reduces the size of wrinkles ¹, ²
- AstaReal® Astaxanthin improves skin texture ¹, ²
- AstaReal® Astaxanthin protects the skin’s collagen layer ¹
- AstaReal® Astaxanthin promotes smooth skin ¹, ²
- AstaReal® Astaxanthin enhances skin elasticity ¹, ², ³
- AstaReal® Astaxanthin reduces skin spots ¹, ²
- AstaReal® Astaxanthin protects skin condition from seasonal stress [low humidity] ³


6 mg/day & 0.74 mg (active dose) / 1 mL cream
6 mg/day
6 and 12 mg/day
Skin Concept: Collagen+AstaReal® Astaxanthin

Hand-in-Hand for Younger-Looking Skin
Harmful free radicals break down collagen in your skin and your skin’s ability to produce more collagen.

You can supplement with collagen and other skin nutrients, but how can you protect these from free radical damage in order to realize the benefits?

Maximize collagen benefits by formulating with AstaReal® - a skin nutrient clinically proven to protect the collagen you have today and the collagen you’ll make tomorrow.
You work hard to keep your skin looking its best. You eat right, drink lots of water, and invest in a robust skin care routine that includes topical and oral supplementation. However, you might not realize that all your hard work is undermined by exposure to harmful free radicals.

Free radicals break down your skin’s natural protein network, and its ability to make new protein, leaving the skin vulnerable to visible signs of aging even with collagen supplementation.

AstaReal® enhances collagen supplementation by protecting skin from free radicals and by preserving natural collagen production keeping skin hydrated, supple, and smooth.
Age and Free Radicals Wear Down Skin Fibroblasts

- Aging reduces collagen, elastin and HLA production
- Environmental ROS damages dermal protein network
- ROS also reduces the capacity of fibroblasts to produce collagen and other skin supporting factors


- UV → ROS → Inflammation → photoaging • DNA damage • apoptosis

https://commons.wikimedia.org/wiki/File:Younger_skin_vs_older_skin.jpg
AstaReal® Preserves Collagen Synthesis

ROS

100% Collagen production

132% Collagen production

0% Collagen production

80% Collagen production

0% Collagen production

108% Collagen production

Vitamin C

+ 32%

Astaxanthin

Vitamin C

Astaxanthin

Vitamin C

Free radical exposure abolishes collagen synthesis

AstaReal® Astaxanthin preserves up to 80% of collagen synthesis

Key Take Away

AstaReal® Astaxanthin preserves up to 80% of collagen synthesis

Tominaga et al., 2009 Food Style 21 13(1):84-86
AstaReal® Astaxanthin Protects Skin Fibroblasts

Human fibroblasts were pre-incubated with astaxanthin and then exposed to singlet oxygen. Protection was measured by level of cell viability rate.

Tominaga et al., 2009 Food Style 21 13(1):84-86
AstaReal® for Eye Health

AstaReal® for Eye Fatigue & Strain
4 - 6 mg/day
Digital Eye Strain – A Real Patient Concern

50-90% of computer users suffer symptoms of Computer Vision Syndrome (CVS) or Digital Eye Strain.

How common are Digital Eye Strain symptoms?
33% report experiencing eye strain
23% report experiencing dry eyes
22% report experiencing blurred vision

WHY is this Happening to our Eyes??
- Eyes are naturally at rest with a view distance of 20 feet away.
- A phone, tablet, or computer, is generally 18-24 inches away.
- Prolonged contraction of ciliary muscles increases ROS and stresses eyes.
- This causes ciliary muscles to spasm to adjust to close proximity viewing.
- Resulting in blurred vision, headaches, and eye fatigue and strain.

10M annual eye exams due to vision problems related to computer use.

Symptoms of Digital Eye Strain

- **65%** of Americans reported symptoms of digital eye strain\(^1\)
- The average American spends **7.5** hours in front of a screen or digital device every day\(^1\).
- **53%** of Americans are using **2** digital devices at the same time\(^1\).
- More than **83%** of Americans use digital devices for more than **2** hours per day.\(^1\) It’s a family affair affecting the entire family\(^1\)
  - 72% ages 0-18  - 88% ages 18-29
  - 83% ages 40-59  - 76% ages 60 and up

TOO MUCH Screen Time

- Headaches
- Eye Strain/Fatigue
- Dry Eyes
- Irritated Eyes
- Blurred Vision
- Reduced Attention Span
- Poor Behavior
- Irritability

1. 2015 The Vision Council US Report. 10,000 Americans in Survey
Eye Fatigue & Digital Eye Strain

The average American spends **7.5 HRS** in front of a screen or digital device every day.

65% of Americans reported symptoms of digital eye strain.

Optometrists recommend the **20-20-20 rule** to give eyes a rest from the digital screen.

Every 20 Minutes

Look 20 feet away for 20 seconds.
Natural lens shape has a focal point set at 20 feet (6m). Viewing anything closer than 20 feet requires:

- Accommodation of the lens
- Constriction of the pupil
- Convergence of the eyeballs

www.webeyeclinic.com/Articles/1380/Ultrasound-Ciliary-Plasty/Ultrasound-Ciliary-Plasty
How Astaxanthin Helps Reduce Eye Fatigue

- Eye Strain and fatigue are often symptoms associated with CVS as well as prolonged exposure to blue light emitted by devices.
- High energy blue light reduces contrast therefore causing eyes to constantly have to re-adjust focus and overwork ciliary muscles.
- Tired ciliary muscles directly cause eyes to feel strained and fatigued.
- Astaxanthin has been shown to improve ciliary muscle endurance and recovery helps with eye strain/fatigue.

AstaReal® Astaxanthin works in the ciliary muscles to help alleviate fatigue and symptoms of Computer Vision Syndrome.
Astaxanthin Mechanism of Action Summary

Cause of Eye Fatigue

The ciliary muscle fatigue causes asthenopia or accommodation failure

Poor blood flow cannot support highly metabolically active organ

Eye inflammation e.g. visible swelling, sensations of heat and pain and redness

Astaxanthin’s Efficacy

1. Increase Ciliary Muscle Recovery and Endurance

2. Improve Capillary Blood Flow and Blood Rheology

3. Inhibit Inflammation via NF-κB pathway
Front to Back Eye Protection

**Lutein/Zeaxanthin**

Back of the Eye Protection
Filters Blue Light

- Crosses blood retinal & blood brain barrier
- Localized to the retina
- Antioxidant
- Anti-inflammatory
- Filters blue light
- Improves visual acuity and contrast sensitivity
- Helps reduce risk of dry AMD
- Improved glare tolerance
- Improved macular pigment optical density

**Astaxanthin**

Front of the Eye Protection
Reduces Eye Fatigue

- Crosses blood retinal & blood brain barrier
- Localized to the ciliary body
- Antioxidant
- Anti-inflammatory
- Improves circulation
- Improves accommodation/focus
- Reduces oxidative stress in aqueous humor

**COMPLETE PROTECTION FOR YOUR EYES**

- **LUTEIN AND ZEAXANTHIN**
  - Help filter out harmful blue light
  - Help night vision & contrast sensitivity

- **ASTAREAL® ASTAXANTHIN**
  - Help reduce eye fatigue & strain
  - Help focusing ability & depth perception

For a complete carotenoid formula that supports the eye from front to back consider formulating AstaReal® Astaxanthin together with lutein and zeaxanthin.

*Illustration by AstaReal, The Natural Astaxanthin of Choice*
## Summary of Clinical Body of Evidence by Dose

### In vivo/vitro study

#### Anti-oxidant effects
- Scavenges reactive oxygen, especially singlet oxygen (Nishida 2007)
- Inhibits lipid peroxidation (Miki 1991)
- Protects cell membrane from oxidative stress comprehensively (Goto 2001)

#### Protection of retinal damage
- Protected retinal ganglion cell (RGC) from oxidative stress, glutamate stress, hypoxia, and UV (Nakajima 2004, Dong 2013, and Yamagishi 2014, and Lennikov 2012)
- Inhibited light-induced retinal dysfunction (Otsuka 2013)

#### Anti-inflammatory effects
- Inhibited NF-κB-dependent signaling pathway in inflamed eyes (Suzuki 2006, and Ohgami 2003)

#### Vasodilating action
- Extended vascular via a vascular relaxing factor NO (Hussein 2005a)
- Shortened the blood microchannel transit time (Hussein 2005b)

### Dosage of Astaxanthin

<table>
<thead>
<tr>
<th>Dosage</th>
<th>Clinical study</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 mg</td>
<td>Anti-oxidant effects blue light</td>
</tr>
<tr>
<td>2 mg</td>
<td>Decreases plasma oxidative stress marker (Kim 2004 and Park 2010)</td>
</tr>
<tr>
<td>4 mg</td>
<td>Improves accommodation and visual acuity (Nakamura 2004)</td>
</tr>
<tr>
<td>5 mg</td>
<td>Improves accommodation and, attenuates symptom of digital eye strain (Nagaki 2002)</td>
</tr>
</tbody>
</table>

- Shows anti-oxidative and anti-inflammatory effects in aqueous humor (Hashimoto 2007, 2009)
- Promotes circulation around optic papilla (Nagaki 2005)
Suggested Structure Function Claims for EYE

- Helps to focus and re-focus strained eyes 1, 2, 3, 4
- Relieves tired eyes [eye fatigue] 5, 6, 7, 8, 9
- Helps alleviate eye strain 1, 3, 9
- Helps eyes resist and recover from screen time 1, 3, 7, 8, 10
- Promotes good circulation and nourishment of eyes 6
- Alleviates oxidative stress in eyes 11, 12, 13, 14
- Helps promote visual acuity 15
- Helps enhance depth perception 16

AstaReal® for Brain Health

2, 6-12 mg/day
Suggested Structure Function Claims at 6-12 mg/day

- AstaReal® Astaxanthin promotes visual reaction time during visual pursuit task\(^1\)
- AstaReal® Astaxanthin improves sleep quality\(^2\)
- AstaReal® Astaxanthin supports healthy blood pressure associated with lower stroke risk and cardiovascular health\(^2\)
- AstaReal® Astaxanthin promotes resilience against mental and physical fatigue\(^3\)

Studies with ASTAREAL® Astaxanthin


- Natural Astaxanthin decreases oxidized red blood cells, which are associated with dementia when present at high levels\(^1\)
- Natural Astaxanthin promotes reduction in age-related forgetfulness, multitasking and alertness\(^2\)
- Natural Astaxanthin promotes faster reaction times (choice reaction, mid and episodic memory, spatial attention)\(^3,4\)

Studies with non-ASTAREAL® Astaxanthin

1. Nakagawa et al., British Journal of Nutrition (2011), 105, 1563–1571. 6, 12 mg/day
2. Zanotta et al., Neuropsychiatric Disease and Treatment 2014:10 225–230. 2 mg/day
Astaxanthin Helps Keep the Brain Healthy

**Complications**

- Age Related Cognition Decline such as forgetfulness, multitasking and alertness
- Poor blood quality such as poor rheology and low oxidative resistance
- Localised inflammation increased oxidative stress burden towards disease conditions
- Increased blood pressure and circulatory damage may increase stroke risk

**Astaxanthin’s Efficacy**

1. Improves mental decline based on CogHealth scores in the elderly
2. Improves blood flow and increases antioxidant capacity
3. Reduces inflammation by the NF-κB pathway
4. Improves endothelia and microcirculatory condition. Lowers pressure.

---

AstaReal
The Natural Astaxanthin of Choice

AstaReal
Be you, Just healthier
AstaReal® for Heart Health

AstaReal® for Heart
2, 6-12 mg/day
Suggested Structure Function Claims at 6-12 mg/day

- AstaReal® Astaxanthin supports blood flow \(^1\), \(^2\), \(^3\), \(^4\), \(^5\), \(^6\)
- AstaReal® Astaxanthin supports capillary blood flow \(^3\)
- AstaReal® Astaxanthin supports blood flow to the eye \(^3\), \(^6\)
- AstaReal® Astaxanthin supports healthy blood chemistry/blood lipid profile \(^7\)

Studies with ASTAREAL® Astaxanthin

5. Tsukahara H. et al. Medical consultation & new remedies. 2009;46(4),:427-32. 6 mg/day
Summary and Conclusion

In summary, clinical and experimental studies suggest that supplementation with 5-18 mg daily of natural astaxanthin can reduce the risk of cardiovascular complications through the following effects.

- Improves lipid metabolism and lipid profile
- Enhances blood rheology
- Improves capillary circulation
- Reduces oxidative stresses in high risk populations
- Inhibits plaque formation by suppressing macrophage uptake of oxidized LDL-C
### Clinical Body of Evidence for 2 mg/day

<table>
<thead>
<tr>
<th>Reference</th>
<th>Dose</th>
<th>Result</th>
<th>Suggested Claims</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iwamoto T et al 2000</td>
<td>1.8mg</td>
<td>5% increase in lag time of LDL oxidation after 2 weeks.</td>
<td>Source of astaxanthin Contains astaxanthin Antioxidant</td>
</tr>
<tr>
<td>Yamashita et al. 2002</td>
<td>2mg</td>
<td>Improved skin hydration at corner of the eyes after 4 weeks compared to placebo group.</td>
<td>Supports skin health</td>
</tr>
<tr>
<td>Park et al. 2010</td>
<td>2mg</td>
<td>Increased plasma AX concentration after 4 weeks. Lowered CRP after 8 weeks.</td>
<td>Source of astaxanthin Contains astaxanthin Antioxidant Supports cardiovascular health</td>
</tr>
<tr>
<td>Kim YK et al. 2004</td>
<td>2mg</td>
<td>Increased HDL after 8 weeks. Reduced triglycerides after 8 weeks. Reduced plasma TBARS after 8 weeks.</td>
<td>Source of astaxanthin Contains astaxanthin Antioxidant Supports cardiovascular health</td>
</tr>
<tr>
<td>Zanotta et al 2014</td>
<td>2mg</td>
<td>Improved cognitive function in combination with other ingredients after 8 weeks.</td>
<td>Supports cognitive health</td>
</tr>
<tr>
<td>Yoon et al. 2014</td>
<td>2mg</td>
<td>Together with collagen, improved skin elasticity and reduced TEWL after 12 weeks. Increased expression of pro-collagen and reduced MMP-1 and -12 collagen degrading enzymes.</td>
<td>Supports skin health</td>
</tr>
<tr>
<td>Reference</td>
<td>Dose</td>
<td>Result</td>
<td>Suggested Claim</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>-------</td>
<td>-------------------------------------------------------------------------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>Iwamoto T et al 2000</td>
<td>3.6mg</td>
<td>26% increase in lag time of LDL oxidation after 2 weeks.</td>
<td>Antioxidant</td>
</tr>
<tr>
<td>Miyazawa T. et al. 2011</td>
<td>3mg</td>
<td>Detectable in plasma after 4 wk</td>
<td>Source of astaxanthin</td>
</tr>
<tr>
<td>Satoh A et al. 2011</td>
<td>3mg</td>
<td>Improved skin brightness, moisture, total condition, and tension after 4 weeks. Supported skin against UV exposure.</td>
<td>Supports skin health</td>
</tr>
<tr>
<td>Imai A 2016</td>
<td>3.57mg</td>
<td>Supported skin moisture and smooth texture after 4 weeks.</td>
<td>Supports skin health</td>
</tr>
<tr>
<td>Saito H 2016</td>
<td>3mg</td>
<td>Improved sleep onset latency (together with zinc)</td>
<td>Supports healthy sleep</td>
</tr>
<tr>
<td>Tsukahara, H. et al. 2016</td>
<td>3mg</td>
<td>Improves skin hydration, reduces redness, improves elasticity, and smoothness after 8 weeks</td>
<td>Supports skin health</td>
</tr>
<tr>
<td>Reference</td>
<td>Dose</td>
<td>Result</td>
<td>Suggested Claims</td>
</tr>
<tr>
<td>----------------------------</td>
<td>------</td>
<td>------------------------------------------------------------------------</td>
<td>-------------------------------------------------</td>
</tr>
<tr>
<td>Malmsten, et al. 2008</td>
<td>4mg</td>
<td>AstaReal® group +27 squats, Placebo group +9 squats in six months.</td>
<td>Athletic performance and endurance.</td>
</tr>
<tr>
<td>Baralic et al. 2015</td>
<td>4mg</td>
<td>Reduced exercise-induced inflammation after 90 days</td>
<td>Supports muscle recovery</td>
</tr>
<tr>
<td>Djordjevic et al., 2012</td>
<td>4mg</td>
<td>Reduced exercise-induced muscle damage markers CK &amp; AST</td>
<td>Supports muscle recovery</td>
</tr>
<tr>
<td>Baralic I et al. 2012</td>
<td>4mg</td>
<td>Decreased TBARS, improved PON1 activity, increased –SH groups, improved redox balance</td>
<td>Antioxidant support during exercise</td>
</tr>
<tr>
<td>Nakamura A et al. 2004</td>
<td>4mg</td>
<td>Improved uncorrected visual acuity and positive accommodation speed after 4 weeks.</td>
<td>Promotes visual focus and accommodation.</td>
</tr>
<tr>
<td>Phetcharat L et al. 2015</td>
<td>4mg</td>
<td>Improved crow’s feet after 4 weeks (no 0 astaxanthin control)</td>
<td>Supports skin health</td>
</tr>
<tr>
<td>Reference</td>
<td>Dose</td>
<td>Result</td>
<td>Suggested Claims</td>
</tr>
<tr>
<td>----------------------------</td>
<td>------</td>
<td>------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Nagaki Y. et al. 2002</td>
<td>5mg</td>
<td>resolution of eye strain symptoms in VDT workers of AX compared to placebo group after 4 weeks. Improved accommodation amplitude after 4 weeks.</td>
<td>Reduces eye strain and supports accommodation. Supports eyes during digital screen use.</td>
</tr>
<tr>
<td>Tajoma T et al. 2004</td>
<td>5mg</td>
<td>Improved respiratory parameters, lipid metabolism during exercise. After 2 weeks, together with vitamin C &amp; tocotrienols.</td>
<td>Supports sustained energy during exercise</td>
</tr>
<tr>
<td>Choi HD et al. 2011</td>
<td>5mg</td>
<td>Reduced oxidative stress markers Malondialdehyde (MDA), isoprostane (ISP) after 3 weeks. Increased SOD and total antioxidant capacity of blood after 3 weeks.</td>
<td>Supports antioxidant capacity</td>
</tr>
<tr>
<td>Kim JH et al. 2011</td>
<td>5mg</td>
<td>Increased SOD and total antioxidant capacity in smokers after 3 weeks</td>
<td>Supports antioxidant capacity</td>
</tr>
<tr>
<td>Reference</td>
<td>Dose</td>
<td>Result</td>
<td>Suggested Claims</td>
</tr>
<tr>
<td>---------------------------</td>
<td>------</td>
<td>--------------------------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Nitta T. et al. 2005</td>
<td>6mg</td>
<td>Amplitude, positive, and negative accommodation (p&lt;0.05). After 4 weeks AX 6mg/day group showed significant improvement compared to 0 weeks (which were not observed in placebo group) for: “My eyes hurt,” p&lt;0.05; “My eyesight is dim,” p&lt;0.01; “My eyes get red easily,” p&lt;0.05; “My shoulders and waist are stiff,” p&lt;0.01; “I get irritated easily,” p&lt;0.05; “My head becomes heavy easily,” p&lt;0.05; “The insides of my eyes are painful,” p&lt;0.05; “My eyes get bleary,” p&lt;0.01; «My eyelids twitch,” p&lt;0.05.</td>
<td>Improves accommodation and attenuates symptom of eye strain</td>
</tr>
<tr>
<td>Nagaki Y. et al. 2006</td>
<td>6mg</td>
<td>Accommodation amplitude (p&lt;0.05). Significant improvement in “dimness of sight” and “stiff shoulders and back,” and an improvement tendency for “heavy head” in AX vs. placebo.</td>
<td>Improves accommodation and attenuates symptom of eye strain</td>
</tr>
<tr>
<td>Nagaki Y. et al. 2005</td>
<td>6mg</td>
<td>Supports retinal capillary blood flow. Improvement tendency in “My eyes tire easily,” a significant improvement in “My eyes get red easily” and an improvement tendency in “My eyes can’t focus properly” in AX vs. control.</td>
<td>Supports retinal capillary blood flow. Attenuates symptom of eye strain</td>
</tr>
<tr>
<td>Takahashi N. et al. 2005</td>
<td>6mg</td>
<td>Accommodative micro-fluctuations (p&lt;0.05). After 2 weeks AX, 2/4 resolved digital eye fatigue. Following 20min rest after VDT work, at 0 weeks no subjects reported improvement in fatigue as the result of rest, but after 2 weeks AX, two subjects responded their eyes had recovered.</td>
<td>Improves accommodation and attenuates symptom of eye strain</td>
</tr>
<tr>
<td>Kajita M. et al. 2009</td>
<td>6mg</td>
<td>Positive accommodation (p&lt;0.05)</td>
<td>Improves accommodation</td>
</tr>
<tr>
<td>Shiratori K. et al. 2005</td>
<td>6mg</td>
<td>Amplitude, positive, and negative accommodation (p&lt;0.01). &quot;blear-eye feeling&quot; and &quot;tendency of irritation&quot; significantly improved in AX vs. placebo (p&lt;0.05)</td>
<td>Improves accommodation and attenuates symptom of eye strain</td>
</tr>
<tr>
<td>Sawaki K. et al. 2002</td>
<td>6mg</td>
<td>Depth perception improved significantly (p&lt;0.05) compared to control.</td>
<td>Improves accommodation</td>
</tr>
</tbody>
</table>
Questions?

Thank You!