

## Looking to nature for healthy vision throughout life



**Xangold<sup>®</sup>**  
natural lutein esters



a natural, bioavailable form of lutein, extracted from marigolds



### Lutein, eye protection and AMD

Good nutrition is essential for maintaining healthy vision throughout life. Research has identified lutein – a yellow carotenoid and powerful antioxidant – as particularly important to eye health. Lutein cannot be made by the body, and so it has to be obtained from the diet. Alternatively, lutein can be supplied by supplements or functional foods.

Lutein, and another carotenoid, zeaxanthin, appear to play crucial roles in the macula, the part of the eye responsible for detailed vision. Lutein and zeaxanthin form the macular pigment and may filter out harmful blue light and act as antioxidants to reduce free radical damage. Supplements and lutein-rich foods can increase the macular pigment density, which has been shown to be associated with a lower risk of Age-related Macular Degeneration (AMD). AMD, an incurable eye disease in which sufferers gradually lose their central vision, is the principal cause of severe sight loss among those over 50 in the developed world. It currently affects up to 30 million people globally, but incidence is expected to triple over the next 25 years as the proportion of older people continues to increase in western populations. (*AMD Alliance*)

Since there is no cure for AMD, prevention appears to be crucial. Some studies suggest that ingesting 6 mg of lutein a day may be beneficial. Since average dietary intake in the West is only 1-2 mg a day, health-conscious consumers are more likely to look to supplements and functional foods to help bridge the gap.



## Lutein esters: a natural part of the diet ...



Esters are natural compounds that form a large part of our everyday diet. Dietary fats, for instance, are compounds in ester form. Daily consumption of dietary fats amounts to tens of grams, but intake of lutein esters is on a much smaller scale – just a few milligrams. The human body is naturally well equipped to break apart the esters from other compound components as part of normal digestion.

Lutein esters – in which fatty acids are 'bound' to lutein – are one of two forms of lutein that occur naturally in our diet. When we eat yellow-to-red fruits and vegetables such as peaches, oranges, papaya, squash and potatoes, we are consuming lutein esters.

## ... and a natural choice for foods and supplements



Lutein products are similarly available in two forms – natural lutein esters such as in **Xangold**<sup>®</sup>, and 'free', unesterified lutein – both of which are derived from marigold flowers, an abundant source of lutein esters.

**Xangold**<sup>®</sup> natural lutein esters undergo the minimum processing necessary to give an excellent quality, yet very natural product, like other natural-source ingredients in the Cognis Nutrition & Health portfolio. Free lutein is subjected to many additional stages of processing, resulting in a highly-refined end product.

## Looking at lutein

- Growing incidence of AMD
- Prevention crucial as disease is incurable
- Mounting evidence that lutein plays a crucial role in eye health
- Average intakes from diet not ideal
- Significant market potential for lutein supplements and lutein-fortified foods

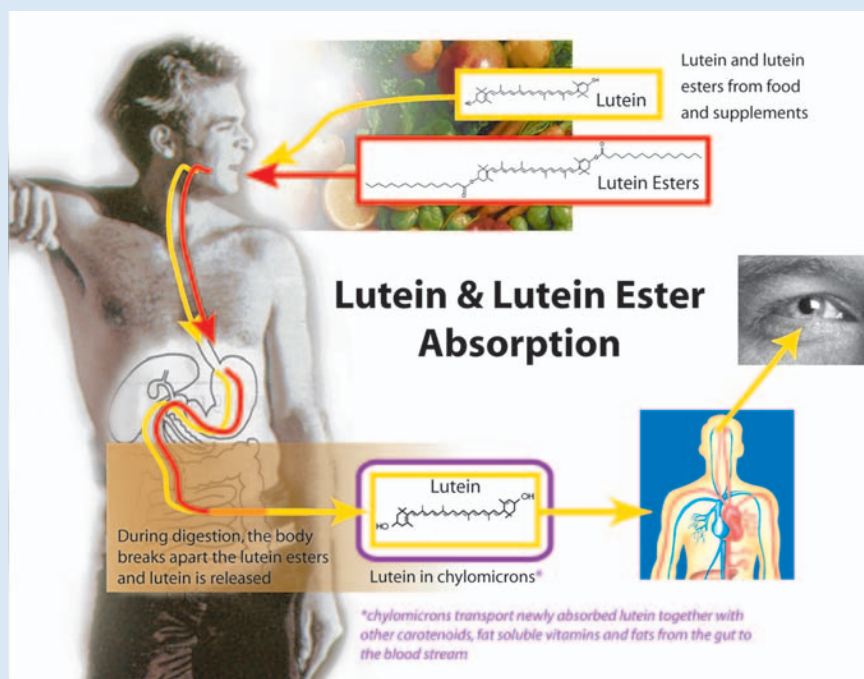
## Focusing on Xangold®

- Excellent bioavailability
- Minimal processing for a natural and high quality product
- Extracted from marigolds grown specifically for Cognis
- Lutein esters found naturally in fruits and vegetables
- First-rate stability
- Available in multiple forms and concentrations
- Safe – USA FDA GRAS notification process completed and no further questions on safety received from the FDA

## Bioavailability of Lutein from Xangold® Natural Lutein Esters

For a substance to provide potential health benefits, it must first be bioavailable to the body:

- Studies show lutein from lutein esters to be at least as bioavailable as that from free lutein and in some cases, *more* bioavailable – see Evidence section right for details.
- During digestion, the body naturally, readily and efficiently breaks apart the lutein esters, releasing lutein, which is then absorbed into the blood.
- Studies have shown that consumption of Xangold® results in increased levels of lutein in the blood and in the macula lutea of the eye – see Evidence section right for details.
- Once the body has absorbed the lutein into the bloodstream, it cannot recognise from which source the lutein was derived – whether from foods or supplements, or from 'free' lutein or from lutein esters.
- Carotenoids, including lutein, are digested and absorbed through a multi-stage process, in the same way as all fat-soluble dietary compounds (triglycerides, cholesterol, phospholipids and fat-soluble vitamins). It is therefore necessary to consume carotenoids - in free and esterified form – with fat.
- Converting lutein esters into free lutein is a natural process for the body.



## Scientific support

**Lutein esters are recognised by the scientific community as a source of lutein. There is substantial evidence to support the existence of an efficient ester cleavage system in the gut and confirm the bioavailability of carotenoids from carotenoid esters.**

## The evidence

- In a comparative, head-to-head study conducted by carotenoid expert Prof. Phyllis Bowen, lutein from a lutein ester formulation was found to have greater bioavailability than from a free lutein formulation. Statistical analysis showed that the lutein from the esterified lutein formulation provided by Cognis “was 61.6% more bioavailable than the unesterified lutein formulation”. While this study clearly demonstrated that esterification is not a limiting factor in lutein bioavailability, Dr. Bowen noted that “the bioavailability of lutein from supplements may depend to a great extent on industrial formulation and processing.”<sup>\*, 1</sup>
- Chung et al.<sup>2</sup> found no differences in the body’s absorption, or bioavailability, of lutein from eggs, spinach and free lutein/esterified lutein supplements. The greatest bioavailability of lutein was found to be from eggs, but there was no difference between the supplements and spinach. Further analysis showed that the lutein bioavailability from soft gel supplements containing Cognis’ **Xangold**<sup>®</sup> natural lutein esters was the same as from a product by Vitamin Power containing free lutein.
- Two recent studies looked at the bioavailability of the carotenoids zeaxanthin and β-cryptoxanthin, both of which are closely related to lutein in their chemical structures. In the study on zeaxanthin, bioavailability was found to be significantly higher from consumption of zeaxanthin esters than from consumption of free unesterified zeaxanthin. Using the same methodology and design, the second study on β-cryptoxanthin found the bioavailability of the esterified and free forms to be indistinguishable.<sup>3, 4</sup>

*\*The lutein formulation was a crystalline suspension in safflower oil (Kemin Industries); the lutein ester formulation was a highly concentrated powder (manufactured for Cognis Corporation); both formulations were packed into gelatine capsules for administration*

*† Study used **Xangold**<sup>®</sup> Lutein esters*

## Other significant research

To date, there have been a substantial number of studies published on lutein esters, including several human clinical trials.

- A number of studies have shown that, upon ingestion of lutein esters, levels of free lutein in blood increase, confirming that lutein esters are easily and readily converted to free lutein in the body (Granado<sup>5,6</sup>, Chung<sup>†,2</sup>, Bowen<sup>1</sup>, Roodenburg<sup>7</sup>, Olmedilla<sup>8,9</sup>, van den Berg<sup>10</sup>, O’Neill<sup>11</sup>, Heinrich<sup>†,12</sup>)
- Further studies investigated the effect of lutein ester supplementation on macular pigment density. These demonstrated that, upon ingestion of lutein esters, the macula pigment density increases significantly, both in healthy people (Berendschot<sup>†,13</sup>, Landrum<sup>14</sup>, Bone<sup>†,15</sup> 2003) as well as in people with early stage AMD (Koh<sup>†,16</sup>). This shows that a diseased macula can accumulate and stabilise lutein from lutein esters and that even those with established AMD may benefit from lutein ester supplementation.

Benefits from lutein supplementation in AMD were demonstrated by the Lutein Antioxidant Supplementation Trial<sup>17</sup>. This 12 month, placebo-controlled intervention study found a 50% increase in macular pigment density, and significant improvements in eye function among elderly men with AMD, following supplementation with either lutein alone, or lutein combined with antioxidants.

*\*The lutein formulation was a crystalline suspension in safflower oil (Kemin Industries); the lutein ester formulation was a highly concentrated powder (manufactured for Cognis Corporation); both formulations were packed into gelatine capsules for administration*

*† Study used **Xangold**<sup>®</sup> Lutein esters*

*NB In the study by Granado et al, small amounts of lutein esters were also detected in plasma. These are believed to be derived from re-esterification in the human body after absorption.*

## References

- Bowen PE et al., *J Nutr* 2002;132:3668-3673
- Chung H et al., *J Nutr* 2004;134:1887-1893
- Breithaupt DE et al., *Br J Nutr* 2004;91:707-713
- Breithaupt DE et al., *Br J Nutr* 2003;90:795-801
- Granado F et al., *Br J Nutr* 1998;80:445-449
- Granado F et al., *Eur J Nutr*. 2002;41:47-53
- Roodenburg AJC et al., *Am J Clin Nutr* 2000;71:1187-1193
- Olmedilla B et al., *Cancer Lett* 1997;114:179-181
- Olmedilla B et al., *Clin Sci* 2002;102:447-456
- van den Berg H et al., *Am J Clin Nutr* 1998;68:82-89
- O’Neil ME & Thurnham DI. *Br J Nutr* 1998;79:149-159
- Heinrich U et al., *J Nutr* 2003;133:98-101
- Berendschot TJ et al., *Invest Ophthalmol Vis Sci* 2000;41:3322-3325
- Landrum JT et al., *Exp Eye Res* 1997;65:57-62
- Bone RA et al., *J Nutr* 2003;133:992-998
- Koh HH et al., *Exp Eye Res* 2004;79:21-27
- Richer S et al., *Optometry* 2004;75:216-230