Blue Light Eye Protective Lenses from Algal Pigments

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BACKGROUND

Astaxanthin is a pigment produced by the microalgae *Haematococcus pluvialis* when exposed to stressful conditions. This compound is a strong antioxidant and absorbs light in the 300-500 nm wavelength range. This includes the high-energy blue and violet portions of the visible spectrum and the longer UV wavelengths. Human exposure to these wavelengths has increased with the permeation of technological screens into our daily lives. Televisions, cell phones and computers emit a light spectrum with a blue spike. This disproportionate exposure to blue light is linked to many health problems, including melatonin suppression and circadian rhythm disruption, glaucoma, cataracts, and macular degeneration.

Proposed is a design for an astaxanthin containing film for eyeglass lenses that is composed of bioplastic made from the algal biomass. The production of these lens films is based on sustainable biomass cultivation and a novel biorefinery concept.

METHOD OF PRODUCTION

The process is outlined in Figure 1. In Step 1, the algae is cultivated with photobioreactor technology based on a model currently operating in Switzerland, which obtains CO_2 from car exhaust and light from street-lights along a highway. Nutrients will be provided by wastewater - *H. pluvialis* grows well on municipal wastewater with no added nutrients and effectively treats the water. Thus, the cultivation process operates sustainably with minimal inputs. Steps 2 and 3, separation and biorefinery, ensure that no part of the biomass is wasted. Green chemistry principles are used throughout steps 2, 3, and 4.

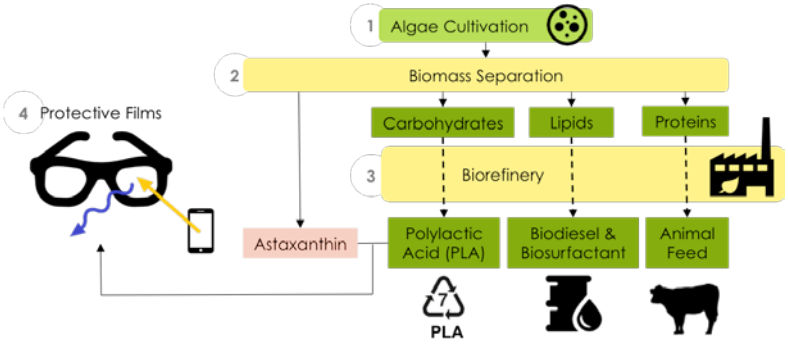

Figure 1: Eyeglass Film Production Method

RESULTS – EYEGLASS FILM DEVELOPMENT

The PLA and astaxanthin are combined in a mixture with an initiator and solvent. The mixed material is shaped using cold extrusion and deposited on the lens by thin-film sputter deposition. The film layer is 8 µm thick with 219 µg/cm^3 astaxanthin concentration. This will block 97.5% of the incoming blue light (at 475 nm). Estimated production from one ton of dried biomass is 141 kg PLA and 15.6 kg astaxanthin, resulting in 2.4 million lens film pairs.