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Effects of Supplementation with Lutein Oral Complex on Eye Dryness, Visual Function and serum lutein level in Healthy Subjects

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ABSTRACT

Dry eye syndrome (DES) has become increasingly prevalent due to the prolonged use of digital devices in modern society. Individual supplementation with lutein, anthocyanins or astaxanthin demonstrated potential benefits for eye health. This study aimed to investigate the effects of lutein complex supplementation on DES, visual function, and serum lutein level in healthy individuals. Twenty-four participants, aged 20~60 years, received lutein complex supplements (containing 10 mg lutein, 2 mg zeaxanthin, 10 mg anthocyanins, 75 mg proanthocyanins, and 1 mg astaxanthin) for 12 weeks. Ophthalmological examinations and blood test were carried out, and a questionnaire was administered at weeks 0, 6, and 12 of the study. After 12 weeks of the intervention, the serum lutein level had significantly increased, and intraocular pressure (IOP) had significantly decreased. It also improved symptoms of eye strain, heavy eyelids, dry eyes, eyes itching, photophobia, blurred vision, sore eyes, blurred vision at night. This suggests that lutein complex supplementation may increase the serum lutein level, reduce the IOP, and offer potential benefits for DES.

Keywords

Lutein, Dry eye syndrome, Visual function, Serum lutein level.

Introduction

Dry eye syndrome (DES) is a common ophthalmological syndrome characterized by dryness and discomfort in the eyes due to insufficient tear production or poor tear quality. Tears play a crucial role in eye health by lubricating the eyeball and providing essential nutrients and protection. When tear production is inadequate or evaporation is too rapid, the protective film on the surface of the eye cannot form properly, leading to DES [1,2]. The symptoms of DES are varied and may include eye strain, heavy eyelids, itching eyes, thick eye discharges, a foreign-matter sensation in the eyes. If left untreated, DES can cause damage to the cornea and conjunctiva, further affecting vision. In modern society, people stare for long periods at digital devices, such as mobile phones, computers, and tablets, and stay in air-conditioned environments, which have led to an increase in the risk of DES

[3,4]. A previous study reported that the global prevalence of DES was 29.5% [5]. In Taiwan, a population-based cross-sectional survey showed that 33.7% of elderly were symptomatic, defined as frequently or always reporting one or more dry eye symptoms [6]. The incidence rate of DES in 2015 in Taiwan was 4.26%, and the incidence rates of DES generally increase with age [7].

Lutein is a carotenoid naturally found in green leafy vegetables and certain fruits, known for its powerful antioxidant properties. It is primarily concentrated in the macula of the eye, where it helps protect the eyes from harmful light and free radical damage. Since lutein cannot be synthesized by the human body, it must be obtained through diet or supplements [8]. Lutein is crucial for eye health, particularly in protecting the retina and maintaining vision. Research has shown that lutein can help prevent eye conditions such as age-related macular degeneration (AMD) [9] and cataracts [8]. While lutein is not a direct treatment for dry eye syndrome, it may provide supportive benefits in alleviating symptoms. Anthocyanins are natural pigments found in various dark-colored fruits and vegetables, such as blueberries, purple grapes, and black soybean seed coat [10,11]. Their strong antioxidant properties help neutralize free radicals, protecting cells from oxidative damage. Previous study suggested that anthocyanins can support the healthy functioning of the lacrimal glands, enhancing tear production and improving eye lubrication, thus alleviating DES [12].

Considering the evidence that lutein supplementation can protect the eyes and anthocyanins can improve DES to the best of our knowledge, the effects of lutein complex supplementation on DES, visual function in healthy subjects are still unclear. Thus, in this study, we aimed to explore effects of the combination of lutein and anthocyanins on dry eye-related indicators and symptoms, visual function in healthy individuals.

Materials and Methods

Study Participants

This clinical trial employed a single-arm design with the following inclusion criteria: male and female volunteers aged 40 to 60, healthy, who either experienced dry eye symptoms or engaged in frequent eye use. The exclusion criteria included individuals who were pregnant, breastfeeding, receiving treatment or currently taking medications, or had any infections, high blood pressure, diabetes, cerebrovascular, cardiovascular, liver, kidney, or gastrointestinal diseases, specific eye conditions, or allergies to any components involved in the study.

Trail Design

This experiment was approved by the Joint Institutional Review Board of Taipei Medical University (N202308022). The 12-week study was conducted at Taipei Medical University Hospital (Taipei, Taiwan), recruiting 24 healthy participants, with an equal number of males and females. All participants were required to take one lutein complex supplement (capsule) daily after breakfast and maintain their habitual diet, exercise routines, while avoiding excessive intake of foods high in lutein or zeaxanthin, as well as other lutein supplements. Assessments of visual functions were conducted at the professional ophthalmology clinic at the baseline, week 6, and week 12. Participants also completed subjective symptom questionnaires to evaluate eye comfort. Additionally, fasting blood samples and blood samples taken two hours after lutein complex supplementation intake were collected to measure serum lutein levels. Compliance with lutein complex supplementation was assessed at the study visits by counting the soft gel supplements that were returned.

Test Supplement and Dosage

The lutein complex supplementation (VITABOX® Free Form Lutein Pro) was a product produced and supplied by VITABOX® Devotion International Co., Ltd. (Taipei, Taiwan). Table 1 shows the composition of the lutein complex supplementation, which included free-form lutein, free-form zeaxanthin, black soybean seed coat extract, grape seed extract and red algae extract (astaxanthin).

Table 1: Ingredient list of the lutein complex supplementation.

Ingredient	Active ingredients	Daily intake
Marigold extract	Free-form lutein	10 mg
	Free-form zeaxanthin	2 mg
Black soybean seed coat extract and grape seed extract	Anthocyanins	10 mg
	proanthocyanins	75 mg
Red algae extract	Astaxanthin	1 mg
Zinc yeast	Zinc	2.5 mg
Selenium yeast	Selenium	100 μg

Dry Eye Syndrome (DES)

Several methods were used to assess DES, including the tear break-up time (TBUT) and a strip meniscometry test. The TBUT was used to assess the stability of the tears, and the strip meniscometry test was used to measure tear secretions. To determine whether lutein complex supplementation could attenuate DES, the TBUT and strip meniscometry test were conducted. All data associated with the eyes are presented as the average of both eyes.

Tear Break-up Time (TBUT)

The TBUT was mainly used to observe the stability of the tear film. After fluorescein dye was instilled into the eyes of a subject, the subject was asked to blink a few times to ensure adequate mixing of the fluorescein dye and then to stop blinking. The time between the last blink and the appearance of the first black spot was measured with a slit lamp. A value of the TBUT below 10 seconds indicated tear instability.

Strip Meniscometry Test

The strip meniscometry test (Echo Electricity, Fukushima, Japan) was used to evaluate tear secretions. After topical anesthesia was applied, calibrated filter paper strips were placed in the lower eyelid for 5 seconds, and readings were measured in millimeters (mm) of the wet strip after 5 seconds. Values of less than 5 mm indicated insufficient tear secretion.

Visual Function

At each visit, subjects underwent a complete ophthalmologic

examination to assess the visual function, including corrected visual acuity, contrast sensitivity, IOP, and central macular thickness.

Corrected visual acuity and IOP were measured using an Auto Ref/Kerato/Tono/Pachymeter TONOREF™ III (Nidek, Gamagori, Japan). Contrast sensitivity (%) indicates an individual's ability to distinguish an object's lightness or darkness compared to the background in a picture with different levels of contrast changes (Figure 1). The central macular thickness was measured using optical coherence tomography (OCT) (Heidelberg Engineering, Heidelberg, Germany). OCT is a noninvasive imaging technique and was established to measure and assess structural parameters within the eye bulbus, such as the macular thickness.

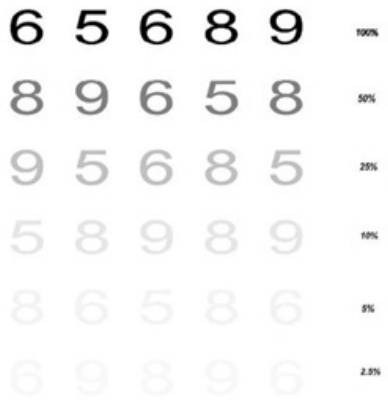

Figure 1: Contrast sensitivity test picture.

Questionnaire of Subjective Symptoms Associated with Eye Comfort

Items of the subjective symptom questionnaire included eye strain, heavy eyelids, eye dryness, itching eyes, thick eye discharges, swollen eyes, sore eyes, foreign-matter sensation in the eyes, photophobia, blurred vision, blurred vision at night, and the eyes tearing involuntarily. The questionnaire consisted of 12 questions. Possible answers to the questions as to the frequency of symptoms within a 1-week recall period were "never", "rarely", "sometimes", "often", and "everyday". Each frequency was assigned a score from 4 to 0. Possible answers to the questions as to the severity of symptoms within a 1-week recall period were "never", "mild", "moderate", and "severe". Each severity level was assigned a score from 3 to 0. Scores for the frequency and severity of each symptom were summed to give a total score for that symptom. In addition, the total score of each subjective symptom represented the score of eye fatigue and dry eye-related symptoms. A higher summary score indicated less eye fatigue and fewer dry eye-related symptoms.

Serum Lutein Level

Absolute alcohol (0.5 mL; containing 10 mg/mL pyrogallol) was added to 0.5 mL of serum, and the solution was mixed in a tube mixer for 30 s. n-Hexane (5 mL; high-performance liquid chromatographic (HPLC) grade) was added, mixed in a tube mixer for 2 min, and centrifuged at 4 °C and 1000 ×g for 5 min. Five milliliters of the supernatant (n-hexane layer) was placed in a brown centrifuge tube, vacuumed, and dried to remove the solvent; 200 µL methanol was added and mixed for even dissolution. A sample (10 µL) and 10 µL of a standard solution were applied to the HPLC system (Hitachi L-7100 intelligent pump, L-7200 autosampler, and L-7455 diode array detector; Tokyo, Japan). The analytical conditions were as follows: reverse-phase C18 HPLC column (4.6 mm × 250 mm × 10 µm); detection wavelength, 450 nm; mobile phase flow rate, 1.0 mL/min; and mobile phase A was methanol, mobile phase B was methanol/acetonitrile (15:85). The concentration of the lutein standard solution was 1000 µg/mL. During analysis, it was diluted with methanol to different lutein concentrations of 6.3, 12.5, 25, 50, and 100 µg/mL to construct a standard concentration curve, which was used to calculate concentrations of test samples.

Statisical Analysis

Data are presented as the mean ± standard deviation (SD) and were analyzed by GraphPad Prism vers. 8.0 software (GraphPad Software, San Diego, CA, USA). During the intervention period, differences among weeks 0, 4, and 8 were compared using a repeated-measures one-way analysis of variance (ANOVA), followed by Tukey's test. Statistical significance was accepted at $p < 0.05$.

Results

Subject Characteristics and Participation

Baseline characteristics of participants in this study are shown in Table 2. In total, 24 participants were initially enrolled in the study at the baseline, including 12 males and 12 females, aged between 20 and 60 years old, with an average age of 24.13 ± 3.86 years. At the 12th-week follow-up, the remaining number of lutein complex supplementation was calculated to assess compliance, with a compliance rate of 94 ± 6% for the participants.

Table 2: Characteristics of enrolled subjects.

	All subjects (*N*=24)
Male	12
Female	12
Age (years)	
21~30	21
31~40	3
Average age of subjects (years)	24.13 ± 3.86

Average age is presented as the mean ± standard deviation ($N = 24$).

Effects of Lutein Complex Supplementation on DES in Healthy Subjects

As shown in Table 3, after 6 and 12 weeks of the lutein complex supplementation intervention, there were no significant differences in the strip meniscometry test for the OD, OS, or OU in healthy subjects. However, there was a trend of increased strip meniscometry test in the OD and the OU. As shown in Table 4, after 6 and 12 weeks of the lutein complex supplementation intervention, there were no significant differences in the TBUT for the OD, OS, or OU in healthy subjects.

Table 3: Effect of lutein supplementation on strip meniscometry test.

	OD	OS	OU
Week 0	2.75 ± 1.11	2.88 ± 1.42	2.81 ± 0.87
Week 6	2.88 ± 1.12	2.33 ± 0.70	2.60 ± 0.69
Week 12	3.29 ± 1.80	2.50 ± 0.78	2.90 ± 0.97

All values are mean ± SD (n=24). OD: Oculus dexter; OS: Oculus sinister; OU: Oculus uterque. Differences between time points were determined by a one-way ANOVA with Tukey's test.

Table 4: Effect of lutein supplementation on tear break-up time (TBUT).

TBUT (sec)	OD	OS	OU
Week 0	4.83 ± 1.63	5.38 ± 1.56	5.10 ± 1.53
Week 6	5.29 ± 1.33	5.42 ± 1.25	5.35 ± 1.26
Week 12	5.29 ± 1.27	5.75 ± 1.42	5.52 ± 1.24

All values are mean ± SD (n=24). OD: Oculus dexter; OS: Oculus sinister; OU: Oculus Uterque. Differences between time points were determined by a one-way ANOVA with Tukey's test.

Effects of Lutein Complex Supplementation on Corrected Visual Acuity in Healthy Subjects

As shown in Table 5, after 12 weeks of intervention with lutein complex supplementation, there was no significant change in corrected visual acuity, whether in the OD, OS or the OU."

Table 5: Effect of lutein supplementation on corrected visual acuity.

Corrected visual acuity (-LogMAR)	OD	OS	OU
Week 0	0.019 ± 0.049	0.024 ± 0.058	0.021 ± 0.053
Week 6	0.019 ± 0.047	0.024 ± 0.058	0.021 ± 0.047
Week 12	0.014 ± 0.035	0.023 ± 0.049	0.019 ± 0.047

All values are mean ± SD (n=24). OD: Oculus dexter; OS: Oculus sinister; OU: Oculus Uterque. Differences between time points were determined by a one-way ANOVA with Tukey's test.

Effects of Lutein Complex Supplementation on Intraocular Pressure in Healthy Subjects

As shown in Table 6, compared to week 0, there was no significant change in the IOP of the OD at week 6, but the IOP of the OD significantly decreased when comparing week 0 to week 12 and week 6 to week 12. In contrast, the IOP of the OS showed no significant change at any time point. The average IOP of both eyes showed no change when comparing week 0 to week 6 and week 6 to week 12, but significantly decreased when comparing week 0 to week 12. The results indicate that after 12 weeks of intervention with the lutein complex supplementation, IOP can be reduced.

Table 6: Effect of lutein complex supplementation on intraocular pressure.

Intraocular pressure (mmHg)	OD	OS	OU
Week 0	16.01 ± 2.76[a]	15.54 ± 3.30	15.78 ± 2.81[a]
Week 6	15.73 ± 2.42[a]	15.10 ±2.42	15.42 ± 2.24[ab]
Week 12	14.34 ± 3.06[b]	14.82 ±2.95	14.58 ± 2.85[b]

All values are mean ± SD (n=24). OD: Oculus dexter; OS: Oculus sinister; OU: Oculus Uterque. Different letters indicate a significant difference between different time points at $p < 0.05$ by a one-way ANOVA with Tukey's test.

Effects of Lutein Complex Supplementation on Contrast Sensitivity in Healthy Subjects

As shown in Table 7, after 12 weeks of intervention with lutein complex supplementation, there was no significant change in contrast sensitivity, whether in the OD, OS or the OU.

Table 7: Effect of lutein complex supplementation on contrast sensitivity.

Contrast sensitivity (%)	OD	OS	OU
Week 0	2.92 ± 1.59	3.13 ± 2.12	3.02 ± 1.80
Week 6	2.81 ± 1.53	2.81 ± 1.53	2.81 ± 1.53
Week 12	2.60 ± 0.51	2.60 ± 0.51	2.60 ± 0.51

All values are mean ± SD (n=24). OD: Oculus dexter; OS: Oculus sinister; OU: Oculus Uterque. Differences between time points were determined by a one-way ANOVA with Tukey's test.

Effects of Lutein Complex Supplementation on Central Macular Thickness in Healthy Subjects

As shown in Table 8, after 12 weeks of intervention with lutein complex supplementation, there was no significant change in central macular thickness, whether in the OD, OS or the OU.

Table 8: Effect of lutein complex supplementation on central macular thickness.

Central macular thickness (µm)	OD	OS	OU
Week 0	267.71 ± 17.01	266.21 ± 18.23	266.96 ± 16.71
Week 6	266.17 ± 18.49	266.88 ± 17.39	266.52 ± 17.33
Week 12	264.67 ± 18.26	269.42 ± 17.97	267.04 ± 17.41

All values are mean ± SD (n=24). OD: Oculus dexter; OS: Oculus sinister; OU: Oculus Uterque. Differences between time points were determined by a one-way ANOVA with Tukey's test.

Effects of Lutein Complex Supplementation on Questionnaire of Subjective Symptoms Associated with Eye Comfort in Healthy Subjects

As shown in Table 8, compared to week 0, the subjective symptoms associated with eye comfort significantly increased after 6 and 12 weeks of lutein complex supplementation. However, there was no statistically significant difference between week 6 and week 12, though there was still a trend of improvement. Significant improvements were particularly noted in symptoms such as eye strain, heavy eyelids, dry eyes, eyes itching, photophobia, blurred vision, sore eyes, blurred vision at night, and eyes strain.

Effects of Lutein Complex Supplementation on Serum Lutein Level in Healthy Subjects

The serum lutein level is considered one of the methods to assess lutein nutritional status. Participants took one lutein complex supplementation daily, and the serum lutein level was measured at weeks 0, 6, and 12. The results are shown in Table 10. After 6 and 12 weeks of lutein complex supplementation, compared to week 0, there was a significant increase in serum lutein level.

Table 9: Effects of lutein complex supplementation on questionnaire of subjective symptoms associated with eye comfort.

Subjective symptoms associated with eye comfort (score)	Week 0	Week 6	Week 12
Eyes strain	4.08 ± 1.25^{c}	5.25 ± 1.26^{b}	5.79 ± 1.41^{a}
Heavy eyelids	5.25 ± 1.39^{b}	6.04 ± 1.33^{a}	6.04 ± 1.40^{a}
Dry eyes	4.54 ± 1.89^{b}	5.79 ± 1.44^{a}	5.75 ± 1.54^{a}
Eyes itching	5.21 ± 1.35^{b}	6.04 ± 1.27^{a}	6.13 ± 1.08^{a}
Thicker eyes discharge	6.00 ± 1.50^{b}	6.42 ± 1.06^{ab}	6.71 ± 0.81^{a}
Foreign matter sensation in the eyes	6.04 ± 1.40	6.38 ± 1.17	6.59 ± 0.83
Photophobia	5.63 ± 1.50^{b}	6.29 ± 1.37^{ab}	6.46 ± 0.93^{a}
Blurred vision	5.83 ± 1.63^{b}	6.33 ± 1.13^{ab}	6.67 ± 0.76^{a}
Swollen eyes	6.29 ± 1.08	6.58 ± 0.97	6.63 ± 0.88
Sore eyes	5.21 ± 1.53^{b}	5.83 ± 1.13^{b}	6.42 ± 1.06^{a}
Eyes tears involuntarily	6.25 ± 1.45	6.54 ± 0.93	6.75 ± 0.90
Blurred vision at night	5.96 ± 1.37^{b}	6.42 ± 1.10^{ab}	6.71 ± 0.69^{a}
Eyes strain	4.08 ± 1.25^{c}	5.25 ± 1.26^{b}	5.79 ± 1.41^{a}

All values are mean ± SD (n=24). Different letters indicate a significant difference between different time points at $p < 0.05$ by a one-way ANOVA with Tukey's test.

Table 10: Effect of lutein complex supplementation on serum lutein level.

	Serum lutein level (ug/dL)
Week 0	0.10 ± 0.03^{c}
Week 6	0.21 ± 0.08^{a}
Week 12	0.16 ± 0.06^{b}

All values are mean ± SD (n=24). Different letters indicate a significant difference between different time points at $p < 0.05$ by a one-way ANOVA with Tukey's test.

Discussion

This prospective, one-group, pretest-posttest clinical study aimed to investigate the effects of daily supplementation with a lutein complex supplementation, taken for 12 weeks, on subjective symptoms of eye fatigue, such as eye strain, temporary blurred vision, and dry eyes, as well as objective clinical indicators in healthy individuals who engage in prolonged eye-intensive work. The results showed that, the participants' serum lutein levels increased significantly by 2.1 times after 6 weeks, and after continued supplementation for 12 weeks, lutein levels remained 1.6 times higher than baseline. After 12 weeks of supplementation, the trial indicated that taking a lutein complex supplementation (10 mg lutein and 2 mg zeaxanthin) for 12 weeks did not affect the corrected visual acuity or contrast sensitivity in the healthy population. According to a previous clinical trial by Nolan et al., healthy adults who were given daily supplementation of 12 mg lutein and 1 mg zeaxanthin for 12 months showed no changes in visual acuity compared to the placebo group, which is similar to the results of this study [13]. Additionally, another randomized, double-blind, placebo-controlled clinical trial showed that healthy adults without any retinal diseases who were given daily supplementation of 10 mg lutein, 2 mg zeaxanthin, and 10 mg meso-zeaxanthin for 12 months, and were tested for contrast sensitivity using the Early Treatment Diabetic Retinopathy Study (ETDRS) chart (Test Chart 2000 PRO), demonstrated a significant improvement in contrast sensitivity compared to the placebo group [14]. However, since the intervention period in this study was 3 months (12 weeks), it is hypothesized that a longer duration of lutein compound supplementation may improve contrast sensitivity in the future.

The results of this experiment indicate that supplementation with a lutein complex (10 mg lutein and 2 mg zeaxanthin) for 12 weeks significantly reduced the average intraocular pressure (IOP) in both eyes of healthy young individuals who are prone to eye strain, temporary blurred vision, dry eyes, and prolonged eye use. Currently, research on the effects of lutein supplementation alone on IOP remains limited and generally shows minimal efficacy. However, previous studies have suggested that astaxanthin may be related to improving elevated IOP. Astaxanthin is a natural carotenoid found in salmon and crustaceans, with strong antioxidant properties. It is known to offer various health benefits, including cardiovascular disease prevention and immune system enhancement [15]. Moreover, increasing evidence points to astaxanthin's efficacy in treating retinal diseases, ocular surface diseases, cataracts, and visual fatigue [16]. Some studies also suggest that astaxanthin has the potential to reduce IOP. In rats with induced elevated IOP, astaxanthin supplementation restored IOP to control levels, and its strong antioxidant properties reduced protein oxidation, lipid peroxidation, and apoptosis caused by high intraocular pressure [17]. Therefore, the reduction in IOP observed in this 12-week supplementation study may be related to the inclusion of astaxanthin in the lutein complex supplementation.

Tear volume plays a protective role on the surface of the eye. When tear secretion is insufficient or tear evaporation is rapid, it leads to reduced moisture on the eye's surface. Over time, this can cause epithelial cells on the cornea or conjunctiva to shed, potentially leading to inflammation and increasing the risk of DES. In this experiment, the strip meniscometry test is related to the amount of tear production, while TBUT is associated with the rate of tear evaporation. The larger the values for strip meniscometry test and TBUT, the lower the risk of developing DES [18]. The results of this study indicate that supplementation with a lutein complex for 12 weeks did not affect strip meniscometry test, but there was a trend of increasing TBUT. Additionally, the self-reported questionnaire results showed a significant increase in scores of dry eyes after supplementation. A previous study by Kizawa et al. also found similar results. After continuous supplementation with a lutein compound containing anthocyanins (60 mg/day), astaxanthin (6 mg/day), and lutein (10 mg/day) for six weeks, the strip meniscometry test, TBUT, and scores on an eye comfort-related questionnaire all significantly improved [19]. This study by Kizawa et al. discussed how anthocyanins could increase nitric oxide (NO) production, which relaxed blood vessels, and astaxanthin was thought to inhibit lipid peroxidation on cell membranes, reducing oxidative damage to red blood cells and maintaining blood flow, thus improving ocular blood circulation. These findings support the idea that while lutein supplementation

may not increase tear secretion, it can improve tear film stability, reduce tear evaporation, and maintain eye hydration. These effects may be related to the inclusion of anthocyanins and astaxanthin in the lutein complex supplementation.

Lutein is a type of carotenoid that is widely present in the human retina. It can filter blue light, protect the eyes, and prevent age-related macular degeneration. However, humans cannot synthesize lutein on their own, so it must be obtained through diet or supplements. Exogenous lutein is absorbed in the intestines along with dietary fats and transported to the liver. In the liver, lutein binds with lipoproteins to form carotenoid-lipoprotein complexes, which are then transported throughout the bloodstream and delivered to the retina, allowing lutein to perform its functions there. Therefore, serum lutein levels can be used as an indicator of lutein nutritional status [20]. Previous randomized, double-blind clinical trials have shown that daily supplementation of 10 mg of free lutein for three months significantly increased serum lutein levels by 89% compared to week 0 [21]. This study also found similar results, with serum lutein levels significantly increasing after 12 weeks of lutein complex supplementation. However, serum lutein levels after 12 weeks were significantly lower than after 6 weeks. Past studies on various lutein supplements have shown that serum lutein level initially rises and then declines following supplementation[14]. Another study suggested that this phenomenon may be due to reduced gastrointestinal absorption of lutein or decreased receptor activity after absorption. Lutein is absorbed from the intestinal epithelial cells via the SR-BI receptor. Continuous lutein supplementation is believed to downregulate SR-BI receptor expression, which may explain the observed phenomenon in this study [22].

This study had some limitations. It was a single-group, pre-post clinical experiment, which overlooked the placebo effect. However, as it remains unclear whether the combination of lutein and anthocyanidin justifies resource investment, this study opted for a simpler design to assess the efficacy of lutein complex supplementation. In the future, double-blind, randomized clinical trials with a placebo group, lutein supplementation group, anthocyanidin supplementation group, and lutein and anthocyanidin complex supplementation group are necessary to ascertain the effectiveness of lutein complex supplementation on DES, visual function.

Conclusion

Consuming one lutein complex supplementation daily for 12 weeks can increase serum lutein levels, help relieve IOP and enhance eye comfort. It also helps improve TBUT, reduce DES, and enhance eye hydration and visual function.

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