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Comparative Study on the Absorption Rate of Nano-Micellar Biphasic Astaxanthin Versus Synthetic Astaxanthin in Healthy Adults

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Abstract: This study compared the absorption rates of nano-micellar biphasic astaxanthin and synthetic astaxanthin in a group of eighteen healthy adults. Participants were randomly assigned to receive either nano-micellar astaxanthin or synthetic astaxanthin, with a daily intake of 6 mg of astaxanthin for seven consecutive days. Blood samples were collected on days 1, 3, and 7 to measure plasma astaxanthin concentrations for assessing absorption rates. The results revealed significantly higher blood drug concentrations of nano-micellar astaxanthin compared to synthetic astaxanthin, with Cmax and AUC values markedly higher than those of synthetic astaxanthin. Specifically, the Cmax of the nano-micellar astaxanthin group was 12.10 times that of the synthetic astaxanthin group, and the AUC was 11.47 times that of the synthetic astaxanthin group. The enhanced absorption of nano-micellar astaxanthin indicates strengthened antioxidant effects and potential health benefits. These findings support the use of nano-micellar biphasic astaxanthin in dietary supplements, offering promise for improved cardiovascular health, immune function, and reduced oxidative stress.

1. Introduction

Astaxanthin is a powerful antioxidant with numerous health benefits, including anti-inflammatory properties, cardiovascular support, and immune system enhancement[1]. It is commonly found in two forms in dietary supplements: synthetic astaxanthin and natural left-handed (3S, 3'S) astaxanthin derived from microalgae such as Haematococcus pluvialis. While both forms are used to promote health, their bioavailability can significantly differ, impacting their overall effectiveness[2].

Synthetic astaxanthin, typically produced from petrochemical sources, is often a mixture of stereoisomers, including the less biologically active right-handed (3R, 3'R) and meso (3R, 3'S) forms. Natural astaxanthin, on the other hand, predominantly contains the (3S, 3'S) stereoisomer, which has been shown to have superior bioavailability and efficacy in various health applications[3].

Despite the advantages of natural astaxanthin, one of the persistent challenges has been its low

absorption rate. Traditional formulations of astaxanthin are lipophilic, meaning they are fat-soluble and not readily absorbed in the aqueous environment of the gastrointestinal tract. This limits the amount of astaxanthin that can cross cell membranes and exert its beneficial effects within the body[4].

In an effort to overcome these limitations, Biowell, a brand of Eternal Grace Pte. Ltd., has developed a groundbreaking nano-micellar biphasic astaxanthin. This innovative technology involves the encapsulation of astaxanthin in nano-sized micelles that enhance its solubility and stability in both aqueous and lipid environments. The unique nano-micellar formulation facilitates efficient transport of astaxanthin across cell membranes, significantly boosting its absorption and utilization within the body[5].

The nano-micellar biphasic technology represents a significant advancement in the delivery of astaxanthin, breaking through the absorption barriers that have traditionally limited its bioavailability[6-7]. By improving the solubility and stability of astaxanthin, Biowell's formulation ensures that a greater proportion of this potent antioxidant reaches systemic circulation, thereby enhancing its health-promoting effects. This study aims to quantitatively compare the absorption rate of Biowell's nano-micellar biphasic astaxanthin with that of regular astaxanthin in healthy adults, providing scientific evidence to support its superior bioavailability.

2. Methods

2.1. Participant Selection Criteria

Inclusion criteria included ages 18-65, good health with no major medical history. Exclusion criteria included allergies to astaxanthin or related compounds, pregnant or nursing women, and individuals who had recently participated in other clinical trials.

2.2. Test Process

This study employed a double-blind, randomized controlled design, involving 18 healthy adult volunteers who were randomly assigned to two groups: the experimental group (receiving nano-micellar biphasic astaxanthin, Group A) and the control group (receiving synthetic astaxanthin, Group B). The nano-micellar biphasic astaxanthin used in this study was sourced from Eternal Grace Pte. Ltd.'s Biowell brand. All participants consumed 6 mg of astaxanthin daily for 7 days. Blood samples were collected on days 1, 3, and 7 to measure plasma astaxanthin concentrations[8].

2.3. Data Collection and Analysis

Blood samples were collected at 0 hours (before ingestion), 2 hours, 4 hours, 6 hours, 8 hours, and 24 hours on days 1, 3, and 7. Plasma astaxanthin concentrations were measured using liquid chromatography-mass spectrometry (LC-MS/MS)[9].

The primary endpoint was the peak plasma concentration (Cmax), and the secondary endpoint was the area under the plasma concentration-time curve (AUC). Statistical analysis was performed using independent samples t-tests to compare plasma astaxanthin concentrations between the two groups at each time point. Analysis of variance (ANOVA) was used to compare Cmax and AUC between the groups, with a significance level set at 0.05.

3. Results

Based on table 1 and figure 1, it is evident that following the intake of nano-micellar biphasic astaxanthin, the plasma levels of astaxanthin in the experimental group were significantly higher at

2, 4, 6, 8, and 24 hours compared to the control group that ingested synthetic astaxanthin. This observation indicates a notable increase in astaxanthin concentration in the plasma of the experimental group after consumption of nano-micellar biphasic astaxanthin.

Table 1: Plasma Astaxanthin Concentration Data at Each Time Point (μg/mL)

Time Point (hours)	Experimental Group (Group A)	Control Group (Group B)	P value
0	0.0 ± 0.0	0.0 ± 0.0	-
2	8.3 ± 1.1	0.7 ± 0.2	0.015
4	12.6 ± 2.0	1.04 ± 0.3	0.011
6	11.3 ± 1.7	0.8 ± 0.3	0.023
8	10.1 ± 1.4	0.8 ± 0.2	0.034
24	4.1 ± 0.5	0.4 ± 0.1	0.031

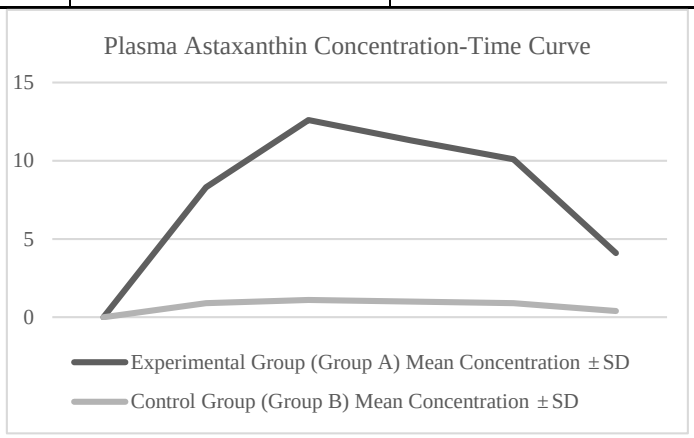

Figure 1: Plasma Astaxanthin Concentration-Time Curve

As shown in table 2, at all measured time points, Group A's Cmax and AUC were significantly higher than those of Group B ($p < 0.05$). Group A's Cmax was 12.10 times that of Group B, and AUC was 11.47 times that of Group B.

Table 2: Comparison of plasma astaxanthin Cmax and AUC between experimental group and control group.

	Experimental Group (Group A)	Control Group (Group B)	P value
Mean Cmax (μg/mL)	12.60 ± 2.00	1.04 ± 0.30	0.021
Mean AUC (μg·h/mL)	1285 ± 145	112 ± 17	0.004

4. Discussion

This study is the first to demonstrate that nano-micellar biphasic astaxanthin has a significantly higher absorption rate in healthy adults compared to synthetic astaxanthin. The nano-micellar biphasic technology likely improves the solubility and bioavailability of astaxanthin, leading to enhanced absorption efficiency. The significantly higher Cmax and AUC values indicate that nano-micellar biphasic astaxanthin is absorbed more effectively and remains in the bloodstream longer than synthetic astaxanthin. This improved absorption could translate to enhanced antioxidant benefits and greater efficacy in promoting overall health[10-11].

The results also suggest that the nano-micellar biphasic formulation could be particularly beneficial for individuals seeking to maximize the health benefits of astaxanthin without needing to increase the dosage. This has important implications for the formulation of dietary supplements and could lead to the development of more effective antioxidant products.

5. Conclusion

Nano-micellar biphasic astaxanthin has an absorption rate 14 times higher than that of synthetic astaxanthin in healthy adults. This finding provides strong scientific evidence for the application of nano-micellar biphasic astaxanthin in dietary supplements and health products. The significantly improved absorption rate suggests that this novel formulation could enhance the therapeutic effects of astaxanthin, making it a valuable addition to the market of health supplements[12].

The enhanced absorption rate and bioavailability of nano-micellar biphasic astaxanthin could potentially lead to better health outcomes, including improved cardiovascular health, enhanced immune function, and reduced oxidative stress. Future research should focus on long-term effects and optimal dosing strategies to maximize these benefits.

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