

ASTAXANTHIN-RICH COPEPODS AS A FUNCTIONAL FEED TO ENHANCE ADULT SHRIMP PIGMENTATION

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INTRODUCTION

Efficient feed development remains a central challenge in aquaculture, where diet directly influences not only growth and survival performance but also key phenotypic traits such as pigmentation. In crustaceans, coloration plays an important role in both commercial and physiological conditions, and is largely driven by dietary carotenoids, particularly astaxanthin.

Copepods are particularly rich in astaxanthin, and recent advances have enabled the selection of strains with enhanced carotenoid content [1]. However, the bioavailability and physiological effects of these enriched live feeds on shrimp pigmentation remain poorly understood. This study investigates the effect of astaxanthin-rich copepod diet on pigmentation dynamics using the freshwater shrimp *Neocaridina davidi* as a model organism.



Figure 1. *Study species used in this research: (left) the freshwater shrimp* Neocaridina davidi[2] *and (right) the calanoid copepod* Pseudodiaptomus annandalei[3].

BACKGROUND

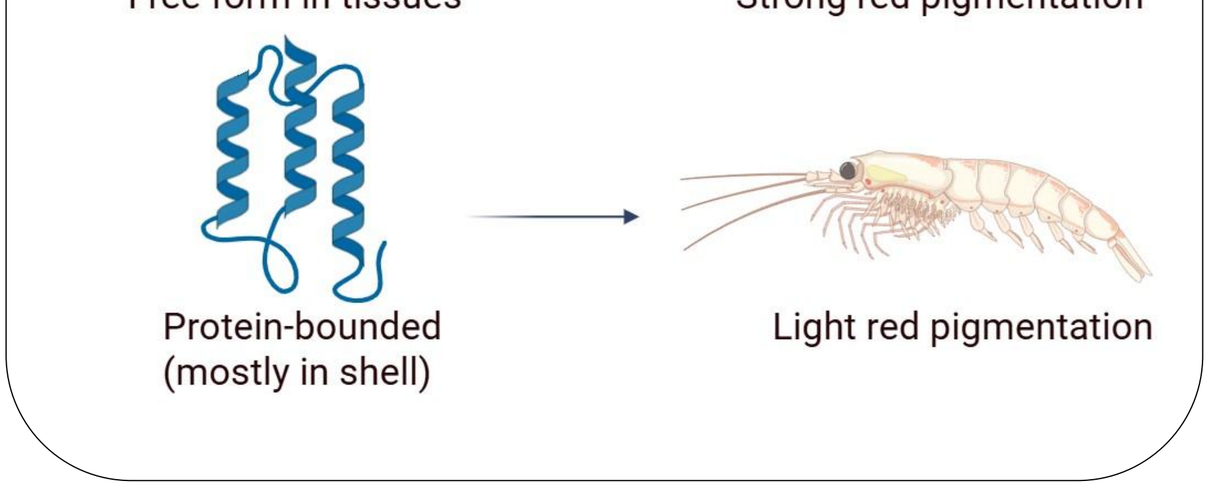


Figure 2. *Different forms of astaxanthin and their influence on crustacean pigmentation. Free astaxanthin is associated with strong red coloration, whereas protein-bound astaxanthin (e.g., crustacyanin) results in altered or lighter pigmentation.* [4],[5].

METHODS

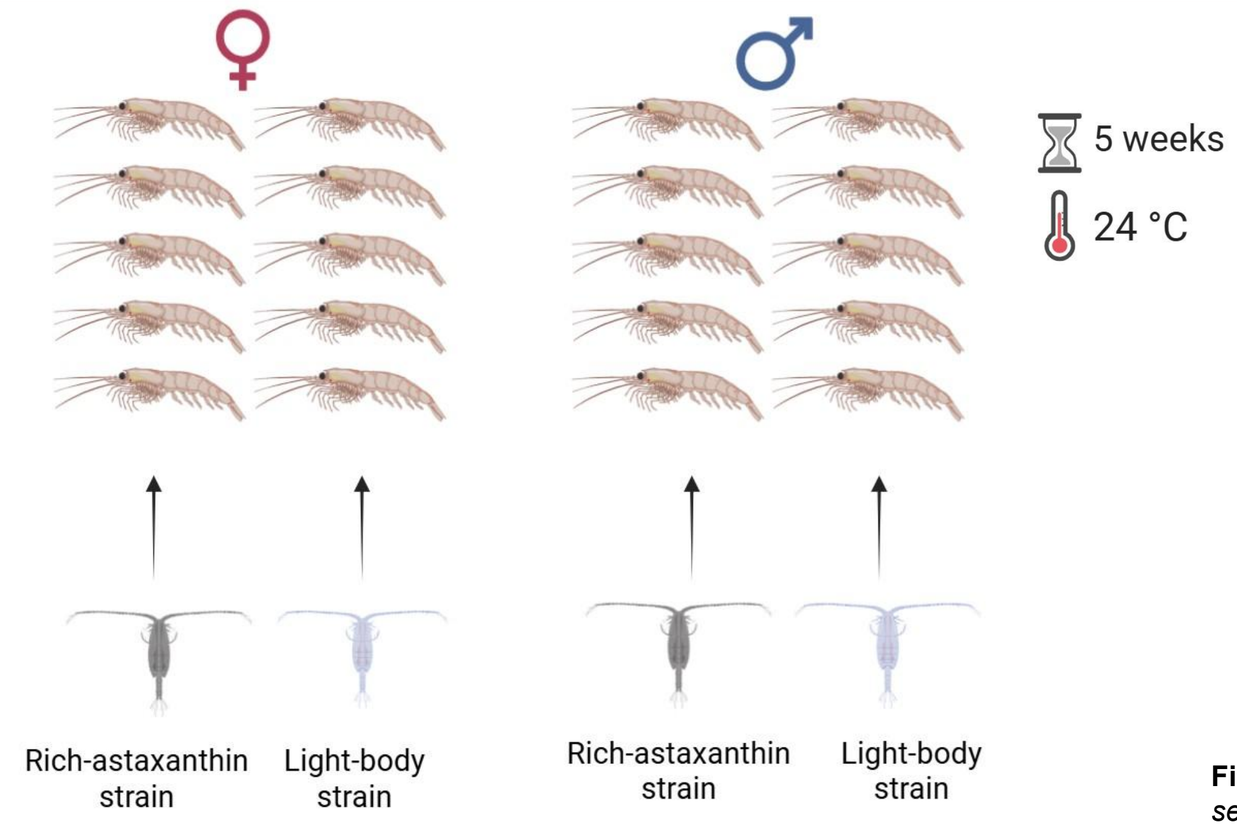


Figure 3. *Experimental design showing the dietary treatments applied to male and female* N. davidi. *Individuals were fed 5* P.annandalei *per day from either an astaxanthin-rich strain or a light-body strain. Each dietary treatment included five males and five females.*

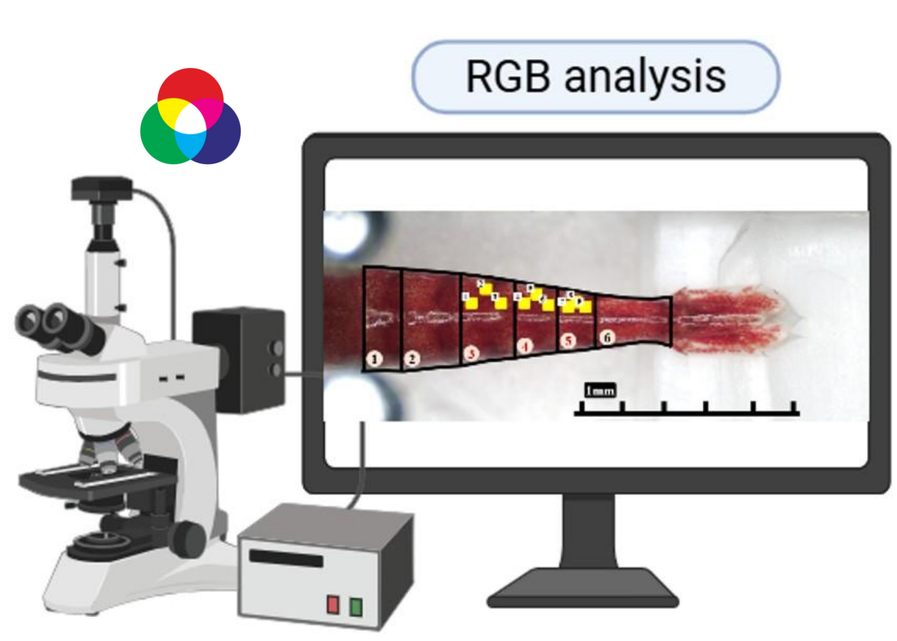


Figure 4. *RGB analysis workflow used to assess pigmentation changes in* N.davidi. *Body segments were photographed weekly using a ZEISS STEMI 305 microscope connected to a LeadView Full Color Cam imaging system. RGB values were quantified using* ImageJ[6] *to monitor pigmentation changes.* RGB measurements were taken from abdominal segments 3–5 using three fixed ROIs per segment (51 × 51 pixels; nine points total). Mean RGB values across the three segments were used for analysis.*Protocol and figure adapted from [7].*

RESULTS

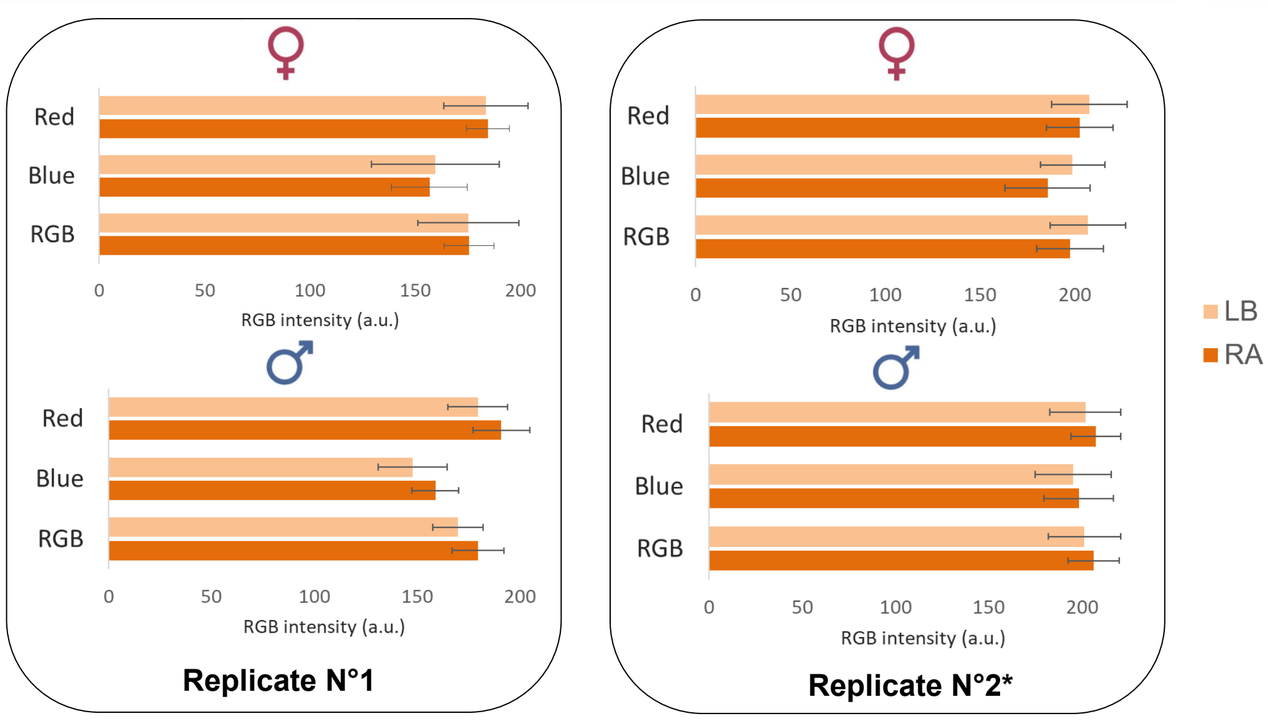


Figure 6. Mean pigmentation intensity under RA and LB dietary treatments across two replicates; bars represent mean ± SD. Lower RGB values indicate darker pigmentation. Replicate 2 showed a clearer diet-related response, whereas Replicate 1 showed weaker or non-significant treatment effects.

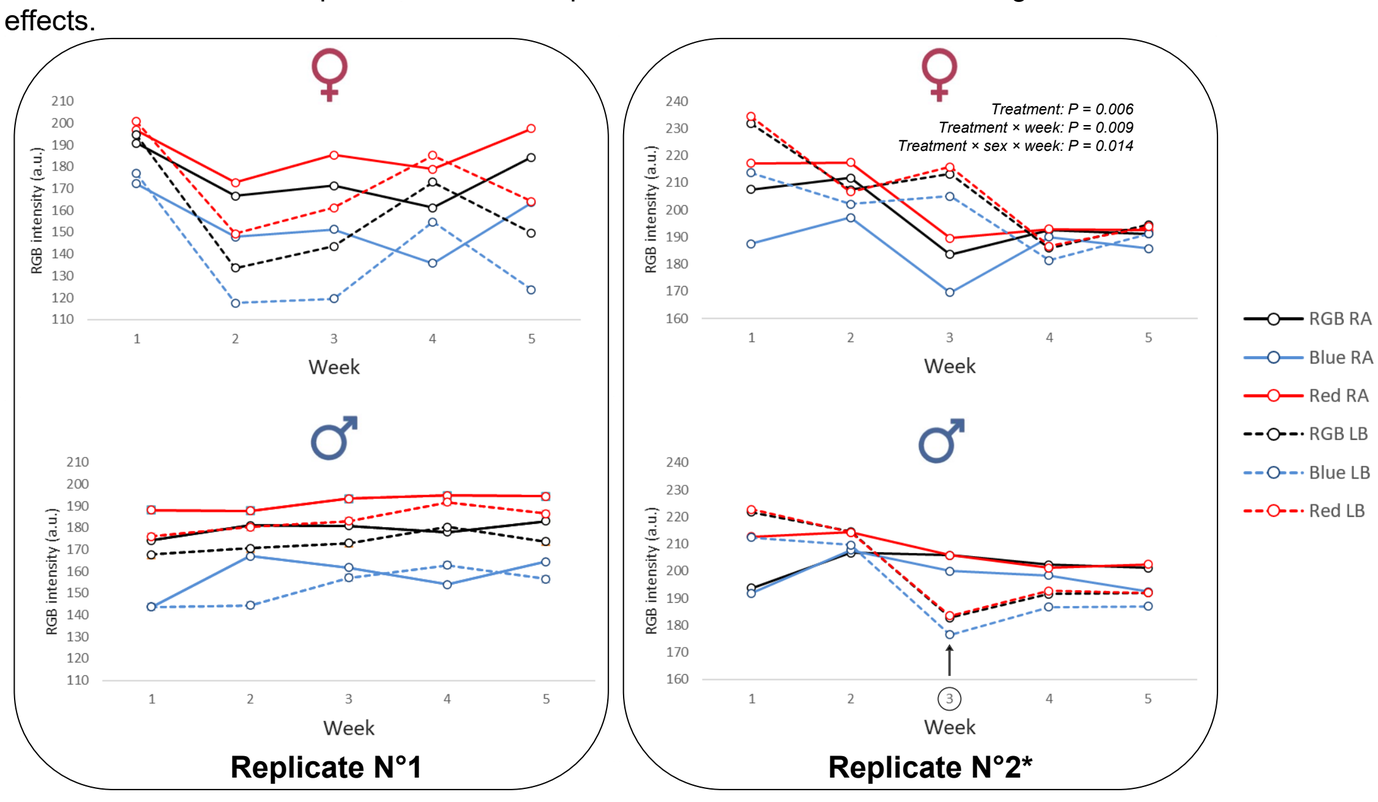


Figure 7. Temporal dynamics of pigmentation intensity under RA and LB dietary treatments across two replicates. Replicate 2 showed a significant time-dependent response to the astaxanthin-rich diet, whereas Replicate 1 displayed weaker or non-significant treatment effects. Week 3 marked the main pigment-response shift.

CONCLUSION / KEY TAKEAWAY

Table 1. Summary of replicate-dependent sex-specific pigmentation responses in *N. davidi*.

Parameter	Replicate 1	Replicate 2*	Main point
Initial state	Blue structural dimorphism	No clear sex gap	Sex pattern differs at baseline
Week 3 Pivot	Stable pigmentation: No change	Divergent pigmentation accumulation: F (Gain) vs. M(Loss)	Main response window
Dietary Response	Weak effect	Sex- and time-dependent response	Replicate-dependent effect

Figure 8. Biological summary of how astaxanthin-rich diet may affect pigmentation dynamics in *N. davidi*.

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