METABOLIC PLASTICITY OF AQUATIC PLANT PROVIDE NEW MODELS FOR SYNTHETIC BIOLOGY

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Aquatic plants exhibit significant plasticity in phenotype and metabolism to adapt to aquatic habitats. Their unique habitats and metabolic plasticity provided advantages in terms of theoretical studies and production. Among them, a fast growing semi-aquatic plant, *Hygrophila difformis*(Acanthaceae), exhibits striking leaf shape variation in response to various ecological factors. Under submerged conditions,*H. difformis* develops complex leaves and in terrestrial conditions it develops simple leaves. We verified that the plant evolved C4-like photosynthesis in submerged condition and established *H. difformis*as a model for studying photosynthesis and heterophylly in higher aquatic plants. We also worked on another group of fast-growing aquatic plants, duckweeds, which are known to be good candidates for biomass production, CO2 capture, and “carbon neutrality”. Our recent work demonstrated that duckweed can thrive on a variety of exogenous organic carbons in the presence and absence of light (photoautotrophic, photoheterotrophic, mixotrophic, and heterotrophic). Among these growth modes, mixotrophic duckweed exploits the advantages of both the photosynthesis and respiration metabolic pathways and grows much faster than its photoautotrophic and heterotrophic counterparts alone or in combination, indicating a synergistic effect and “crosstalk” between chloroplasts (photosynthesis) and mitochondria (respiration). Our studies establishes duckweed as a model for exploiting the metabolic switch for enhanced photosynthetic production of fuels and food, and will also accelerate the engineering and industrialization of duckweeds for bioenergy and biomaterials.

Keywords: Aquatic plant; *Hygrophila difformis*; Heterophylly; Duckweed; Trophic modes; Photosynthesis, Metabolic plasticity