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High quality and quantity duckweed biomass production & protein, starch biosynthesis

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Duckweeds are the smallest and fastest-growing flowering plants and represent a promising source of high-value aquatic biomass. Here, we summarize recent progress from our group in duckweed research. More than 10 years studies in a 0.33-ha production system in Yunnan demonstrated that duckweed can generate abundant biomass under practical cultivation conditions, with annual biomass productivity reaching 39.2–55.0 t ha⁻¹. Beyond high yield, duckweed also showed clear quality advantages over water hyacinth, characterized by higher nutritional value and lower lignocellulosic components. These features support its potential as a digestible and nutrient-rich feed ingredient. Consistently, pig feeding trials showed that duckweed supplementation improved growth performance compared with the control diet, with a 46.15% increase in average daily gain and a 43.71% reduction in the feed-to-gain ratio. Improvements in meat quality further supported the practical value of duckweed for animal production. Further mechanistic and genetic studies revealed that cultivation optimization and physiological induction can promote starch accumulation above 75% of dry weight, associated with altered carbon allocation and reduced lignocellulosic components. In parallel, high-protein duckweed strains with protein contents exceeding 50% were selected, and several genes associated with enhanced nitrogen assimilation and protein accumulation were cloned and functionally characterized, providing targets for improving protein production. Efficient genetic transformation systems have also expanded the application of duckweed as a plant bioreactor for recombinant protein production, including edible vaccines. Together, these studies establish duckweed as a high-quality biomass resource and a versatile synthetic biology platform for future food, feed, and plant-based biomanufacturing.

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