

at preset times and quantities, but such fixed programs can still cause underfeeding or overfeeding because they do not respond to real-time appetite changes (Zhang et al., 2023). This limitation is important for mud crab aquaculture, where feeding demand varies with molt stage, as postmolt juveniles show much higher growth rate and feed conversion efficiency than intermolt individuals.

Recent intelligent aquaculture systems attempt to solve this limitation by combining sensors with machine vision or deep learning. A computer-vision-based feeding system detected wave patterns generated by feeding activity and integrated water-quality sensing, reaching 93.2% accuracy in feeding decisions under aquaculture conditions. Likewise, a dynamic feeding method based on a multi-task neural network achieved 95.44% accuracy in classifying feeding activity while also estimating uneaten pellets, allowing real-time adjustment of feeding intervals and feeding endpoint (Wang et al., 2022). Although these systems were developed mainly for fish rather than mud crabs, they provide a strong technical model for future crab farming because they address the central weakness of fixed quantitative feeding: poor responsiveness to actual feeding demand. Scheduled and quantitative feeding currently has the strongest direct evidence base in mud crab culture, restricted feeding appears to improve efficiency but usually reduces growth, and automated intelligent feeding remains promising but still largely extrapolated from broader aquaculture systems.

4 Effects of Different Feeding Frequencies on Mud Crab Growth Performance

4.1 Weight gain and specific growth rate

Feeding frequency influences weight gain and specific growth rate, but the effect is not uniform across life stage and production system. In grow-out or fattening conditions, several studies found that changing frequency from once to multiple meals per day did not significantly change growth, even when one schedule still produced numerically better results. In a 60-day RAS trial with *Scylla serrata*, feeding frequency did not significantly affect growth or survival, although feeding once daily at 10 pm produced the highest mean weight gain and SGR, reaching 52.00 ± 21.17 g and 5.04 ± 0.14 , respectively (Mayzuri et al., 2025). A second RAS apartment-system study likewise reported no significant effect of feeding once, twice, or three times daily on growth parameters, suggesting that within controlled fattening systems, crabs can maintain similar growth across moderate feeding schedules (Diatin et al., 2026).

Other evidence indicates that more frequent feeding can improve growth when animals are at earlier or physiologically more sensitive stages. In *Scylla olivacea* larvae, feeding rotifers three times daily produced greater absolute growth by day 6 than one or two daily feedings, showing that high-frequency feeding better supports early larval growth. A separate study on mud crabs maintained under different feeding frequencies reported weight growth of 108 g and a daily growth rate of 1.55% with trash fish, indicating that frequency treatment can coincide with measurable growth differences under basket-based maintenance conditions. More broadly, inadequate feed availability suppresses SGR because growth depends on retained energy exceeding maintenance costs, a pattern also observed in juvenile crablets under lower prey availability (Sulaeman et al., 2024).

4.2 Feed utilization efficiency

The effect of feeding frequency on feed utilization efficiency appears weaker and less consistent than its effect on growth. In the RAS apartment-system study, feeding once, twice, or three times daily had no significant effect on feed utilization efficiency or FCR, indicating that increasing meal frequency alone does not guarantee better conversion of feed into biomass (Diatin et al., 2026). This interpretation is consistent with broader nutrition trials showing that mud crab feed efficiency often responds more strongly to diet composition than to feeding schedule. For example, changing carbohydrate and lipid ratios in 35% isoprotein diets did not significantly alter FCR or other feed-efficiency indicators over 60 days (Al., 2024).

At the same time, the wider mud crab literature suggests that efficient feed use depends on matching feeding regime to dietary quality and physiological demand. Juvenile *S. serrata* achieved their best growth and feed efficiency at about 40% crude protein, with improvements in FCR, protein efficiency, and nutrient retention over higher- or lower-protein diets. Feed utilization also shifts strongly across the molt cycle: feed conversion, protein retention,