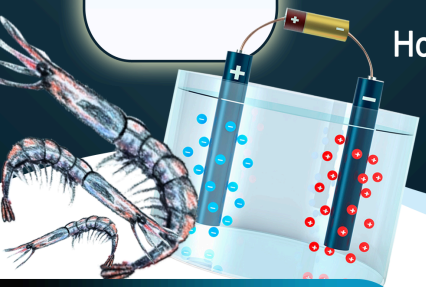
THE IMPACT OF ELECTROLYZED WATER ON WHITE SHRIMP *Penaeus vannamei* CULTURE

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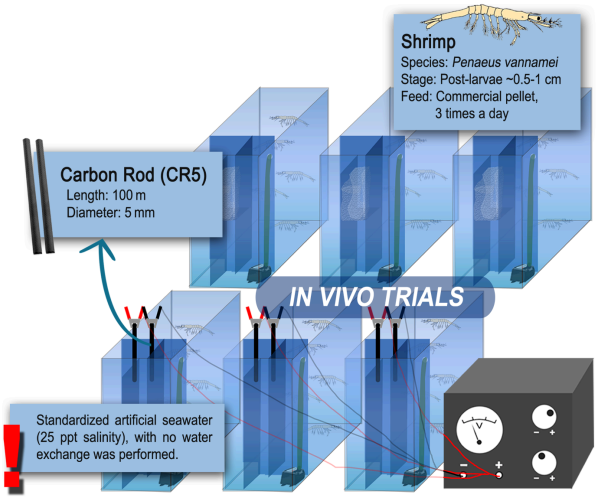
INTRODUCTION

- Water quality directly affects the growth and productivity of aquatic species, making its management vital for successful aquaculture (Aljehani et al., 2023).
- Traditional chlorination lacks dosing precision and risks chemical residues, potentially fostering resistant pathogens in aquaculture (Yeh et al., 2013).
- Electrolyzed water (EW) generates HOCl *in situ* that effectively maintain microbial load, and degrade nitrogenous contaminants (Atrashkevich et al., 2024).
- Despite its proven efficacy in other fields, the practical application of *in situ* EW specifically for shrimp aquaculture remains limited.

Specific Aim:

- This study evaluates the effects of an EW system on water quality, bacterial load reduction, and the growth of whiteleg shrimp culture.

METHODS



Experiment	Purpose	Setup	Treatments	Measurements
Abiotic Phase (Optimization)	Optimize system evaluate the interactions between voltage, current and different electrodes	• 3 x 3 L glass beakers • Electrodes immersed 5 cm and 5 cm spacing	**4 electrical levels:** • Low Voltage–Low Current (LVLA) • Low Voltage–High Current (LVHA) • High Voltage–Low Current (HVLA) • High Voltage–High Current (HVHA) **under 4 electrode materials**: 5 mm and 8 mm carbon rods (CR5, CR8), a 20 mm graphite rod (GR), and a 12K woven carbon fiber sheet (CF).	Water quality including Total Residual Chlorine (TRC)
In vivo Phase (Shrimp Trial)	Evaluate safety & efficacy on *P.vannamei*	• 6 Tanks (8-L) • 5 shrimp per tank	• **Control** (No EW) • **EW Treatment** (LVLA)	• Water quality including TRC and nutrients • Total Heterotrophic Bacteria (THB) • Survival and Growth of the shrimp

RESULTS

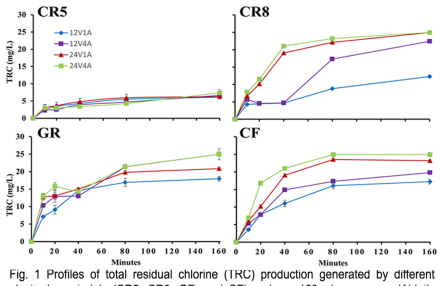


Fig. 1 Profiles of total residual chlorine (TRC) production generated by different electrode materials (CR5, CR8, GR, and CF) under a 160-min exposure (Abiotic phase).

EW system optimization showed that CF and GR produced excessive TRC, making them unsuitable for aquaculture; therefore CR5 was selected for *in vivo* trials (with LVLA settings) due to its lower TRC (Fig. 1).

During the 30-day *P. vannamei* culture, EW maintained safe TRC levels, reaching 0.89 mg/L (Fig. 2). Water quality improved with significantly higher DO and ORP ($p < 0.05$), stable temperature and salinity, and reduced ammonia via electrochemical oxidation (Fig. 3).

Biological performance enhanced significantly, showing a 67.6-fold lower bacterial load and higher specific growth rate (7.65% vs. 6.59%, $p < 0.05$). These results, driven by reactive chlorine species like HOCl, demonstrate EW's potential as a sustainable in situ treatment strategy.

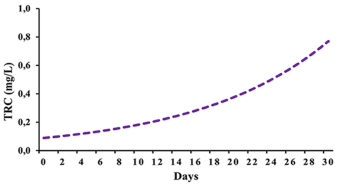


Fig. 2. Daily total residual chlorine (TRC) concentrations during the in vivo phase under control and electrolyzed water (EW) treatments (1 min/day electrolysis). TRC levels were measured daily at a single time point immediately following power supply termination.

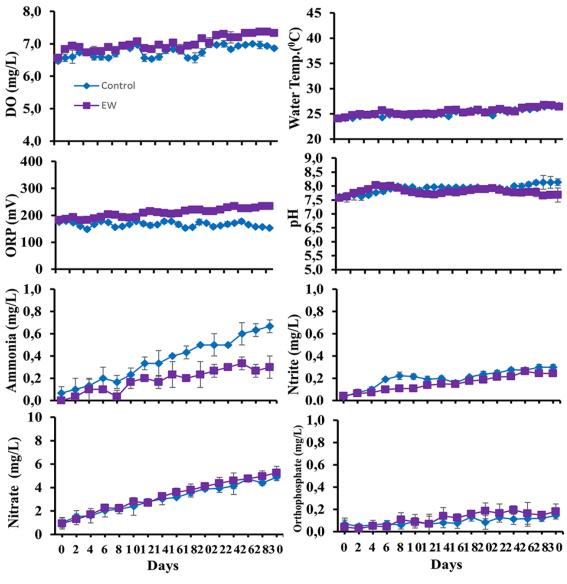


Fig. 3. Physicochemical water quality and nutrient concentrations during the in vivo phase under control and electrolyzed water (EW) treatments: (a) dissolved oxygen (DO), (b) water temperature, (c) oxidation-reduction potential (ORP), (d) pH, (e) ammonia-nitrogen, (f) nitrite-nitrogen, (g) nitrate-nitrogen, and (h) orthophosphate.

CONCLUSION

The optimized EW system significantly enhances the culture environment and suppresses microbial loads through controlled *in situ* disinfection. These improvements directly support enhanced shrimp growth rates and production stability. Overall, this technology serves as a sustainable alternative for maintaining biosecurity and productivity in intensive *P. vannamei* farming.