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SCIENTIFIC NOTE

Control of ectoparasite *Argulus* sp. infestation in the Pacific Fat Sleeper, *Dormitator latifrons* (Richardson)

Control de la infestación del ectoparásito *Argulus* sp. en el dormilón gordo del Pacifico, *Dormitator latifrons* (Richardson)

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ABSTRACT

Argulosis, caused by the ectoparasitic crustacean *Argulus* sp., represents a significant threat to the aquaculture of various species, including the Pacific fat sleeper (*Dormitator latifrons* Richardson). In response to this issue, the present study evaluated the efficacy of potassium permanganate as a treatment for controlling argulosis in *D. latifrons*. A total of 200 juvenile fish naturally infested with *Argulus* sp. were collected from the wild and maintained under controlled laboratory conditions. Fish were exposed to three concentrations of $KMnO_4$ (5, 10, and 20 mg/L) in short-term immersion baths lasting 30 minutes. Results showed that the 10 mg/L concentration effectively eliminated *Argulus* sp. infestation without causing noticeable damage or mortality in the fish. These findings indicate that potassium permanganate is a viable chemotherapeutic option for the control of *Argulus* sp. in *D. latifrons*, establishing 10 mg/L for 30 minutes as the optimal recommended dose.

KEYWORDS

Argulosis, $KMnO_4$, aquaculture, native fish.

RESUMEN

La argulosis, causada por el crustáceo ectoparásito *Argulus* sp., representa una amenaza significativa para la acuicultura de diversas especies, incluido el dormilón gordo del Pacífico (*Dormitator latifrons* Richardson). Ante esta problemática, el presente estudio evaluó la eficacia del permanganato de potasio como tratamiento para el control de la argulosis en *D. latifrons*. Para ello, se recolectaron 200 peces juveniles infestados naturalmente con *Argulus* sp. y se mantuvieron bajo condiciones controladas de laboratorio. Los peces fueron expuestos a tres concentraciones de $KMnO_4$ (5, 10 y 20 mg/L) mediante tratamientos de inmersión corta de 30 minutos. Los resultados demostraron que la concentración de 10 mg/L eliminó eficazmente la infestación por *Argulus* sp. sin causar daños ni mortalidad evidente en los peces. Estos hallazgos sugieren que el permanganato de potasio es una opción quimioterapéutica viable para el control de *Argulus* sp. en *D. latifrons*, estableciendo 10 mg/L durante 30 minutos como la dosis óptima recomendada.

PALABRAS CLAVE

Argulosis, $KMnO_4$, acuicultura, peces nativos.

Parasites are a major stress factor and are considered crucial limiters of aquaculture development, causing significant socioeconomic impacts in many of the fish-producing countries (Ferreira et al., 2021). *Argulus* is a genus of ectoparasitic crustaceans commonly referred to as fish lice, which causes the disease known as argulosis (Walker et al., 2004). *Argulus* attaches to the host by means of maxillary suckers and feeds on mucous membranes, epithelial cells, blood, and tissue fluids. This aggressive feeding activity produces direct effects such as dermal ulceration, osmotic imbalance, immunosuppression, physiological stress, and overall reduced host health (Sahoo et al., 2021; Thakur et al., 2023). It also causes indirect effects such as infections by opportunistic bacteria of the genera *Aeromonas* and *Pseudomonas*, co-infections with other parasites such as *Ichthyophthirius multifiliis* and *Ichthyobodo* sp., reduced fish growth and development, decreased feed conversion rate, and, in severe cases, host mortality (Haridevamuthu et al., 2024). Reported symptoms include unusual swimming patterns, irritation, inflammation and skin lesions, hemorrhages, emaciation, darkened body coloration, red, white, or black spots across the abdominal region, sunken eyes, and irregular fins (Aalberg et al., 2016). In recent years, the occurrence of argulosis appears to be increasing due to the intensification of aquaculture production (Sahoo et al., 2021). It has become a silent but persistent threat; although this small crustacean may go unnoticed to the naked eye, it has a considerable impact on fish production worldwide (Brahmchari et al., 2023).

Potassium permanganate ($KMnO_4$) has been used effectively as a strategy to control argulosis both *in vitro* (Cardoso et al., 2020) and *in vivo* in carp species such as *Labeo rohita* (Hamilton) (Thakur et al., 2023) and *Catla catla* (Hamilton) (Al Mamun et al., 2021). When $KMnO_4$ dissolves in water, it dissociates and the permanganate ion (MnO_4-) reacts with organic molecules, especially electron-rich compounds such as lipids, proteins and enzymes in the membrane of *Argulus* (Noga, 2010). Damage at the cellular level interferes with its metabolic processes, generates osmotic imbalance, and compromises the structural integrity of its tissues, reducing the parasite's ability to survive in the host (Noga, 2010). In addition to affecting *Argulus*, $KMnO_4$ also eliminates bacteria and other microorganisms that could take advantage of fish weakened by parasitic infections, thus improving overall water quality and reducing the risk of secondary infections (Piezer et al., 2021).

However, being an oxidizing agent, $KMnO_4$ can also damage important tissues such as gills and skin; nevertheless, the severity of this damage depends on the concentration used (França et al., 2011). In this context, the objective of this research was to determine the optimal and effective dose of $KMnO_4$, to treat *Argulus* infestations in *D. latifrons*.

Two hundred wild juveniles of *D. latifrons* (19.4 ± 4.5 g weight and 10.28 ± 1.2 cm length) infested with *Argulus* sp. were collected from the "El Ermitaño" estuary in the town of Cruz de Loreto (Tomatlan, Jalisco, Mexico). The organisms were transported in a 1,000 L plastic container. The study was conducted at the Laboratorio de Calidad de Agua y Acuicultura Experimental, part of the Centro Universitario de la Costa in Puerto Vallarta, Jalisco, Mexico. The specimens were kept under a 7-day acclimation process 600 L tanks, equipped with a canister type filter (SERIE EF-05® BOYU de Mexico, Mexico City, Mexico), and constant aeration. Water temperature was maintained at 23.0 ± 1.0°C with a heater (Thermal Pro® 200w, Aqueplantas MX, Iztacalco, Mexico); dissolved oxygen was maintained at 5.5 ± 1.0 mg/L and measured with an oximeter (HI9146-04, Hannapro, S.A. de C.V., Mexico City, Mexico), pH was 8.1 ± 0.3, measured with a potentiometer (HI8314, Hannapro, S.A. de C.V., Mexico City, Mexico). Fish were fed to apparent satiety once a day (16:00h) and a 12 h light/12 h dark photoperiod was adopted.

After acclimatization, the tanks were assigned to four groups with three replicates and 15 organisms per unit: three treatments with $KMnO_4$ (CAS 7722-64-7) at 5 mg/L, 10 mg/L and 20 mg/L for 30 min, and a control group (no $KMnO_4$ exposure). The concentrations were based on $KMnO_4$ levels commonly used to treat external parasites in aquaculture (Noga, 2010), along with a preliminary test. Based on this, 5 mg/L and 10 mg/L (Chandra, 2006) 20 mg/L (from in the preliminary test) were selected as potentially effective. All treatments were observed for 15 days after exposure to monitor potential recurrence of parasite infestations. Criteria for assessing general fish health and behavior included increased respiration (rapid breathing due to

gill damage), irritation (rubbing against surfaces due to skin and gill irritation), behavioral changes such as lethargy (slow movement or inactivity), erratic swimming or loss of balance. Mortality was also recorded (Misganaw & Getu, 2016).

Morphological identification of *Argulus* sp. is primarily based on distinctive features adult males, such as the length or width of the carapace and abdomen, dorsal carapace ridges, respiratory areas, leg pigmentation, abdominal lobes and incisions, and the presence of a small coxal region in the swimming appendages (Sahoo et al., 2013). This task requires experienced taxonomists. Therefore, species-level identification of the *Argulus* specimens parasitizing *D. latifrons* was not possible, given the lack of determination keys and records of species distributed in the coastal zone of the Mexican Pacific (Vega-Villasante et al., 2017).

$KMnO_4$ has clear prophylactic and therapeutic value in aquaculture to prevent and treat lesions, bacterial and fungal infections, and parasitic diseases such as argulosis (Aly et al., 2020). Its use has been effective in species such as Indian carp (*C. catla*) at 1 mg/L for 5 min (Chandra, 2006), and in goldfish *Carassius auratus* (L.) using baths of 2-5 mg/L for 30 min (Yildiz & Kumantas, 2002). In the present study, treatment with 10 mg/L $KMnO_4$ completely eliminated *Argulus* sp. infestation after 30 min of exposure, with 100 % host survival (Figure 1). In the 5 mg/L $KMnO_4$ treatment, only one ectoparasite remained attached to a fish, which was manually removed, and survival was also 100 %.

Figure 1. Specimen of the genus *Argulus* found parasitizing specimens of *Dormitator latifrons*. Image taken by Kevin Ponce using a stereoscopic microscope (VE-S1).

Treatment with 20 mg/L of $KMnO_4$ was not considered effective, as it caused high mortality in the experimental fish. The mechanism of action of oxidizing agents such as potassium permanganate is based on their ability to generate free radicals (ROS) during oxidative reactions in water, acting as destructive agents against pathogens such as *Argulus* sp. However, ROS can also interact with fish biomolecules such as DNA, proteins, and lipids, causing oxidative stress, especially at high doses or with prolonged exposure (He et al., 2024). Therefore, concentrations of $KMnO_4$ above 20 mg/L administered for 30 min are not recommended for *D. latifrons*. The control group showed a 100 % survival of both ectoparasites and hosts. Figure 2A shows the fish infested with *Argulus* sp. before treatment with $KMnO_4$, and Figure 2B shows the fish after treatment with no visible presence of the parasite.

After 15 days of observation, none of the fish showed reinfestation by *Argulus* sp. Based on these findings, a concentration of 10 mg/L was selected for subsequent experiments as a potential disinfectant for juvenile and adult *D. latifrons* infected with *Argulus* ectoparasites.

The economic threshold for infestations by *Argulus* sp. has yet to be determined and is likely to vary among different production systems. Rather than waiting for visible damage to occur, the application of control measures should complement preventive actions once the predetermined action limit has been reached. An effective control strategy may rely on a combination of chemical, mechanical and biological treatments (Vega-Villasante et al., 2017).

$KMnO_4$ is effective in reducing infestations of *Argulus* sp. in *D. latifrons*. However, its use must be carefully regulated to avoid toxic effects that could compromise the health of the treated organisms. For *D. latifrons*, the optimal recommended concentration (10 mg/L) can eliminate 100 % of *Argulus* sp. infestations without visibly harming the specimens.

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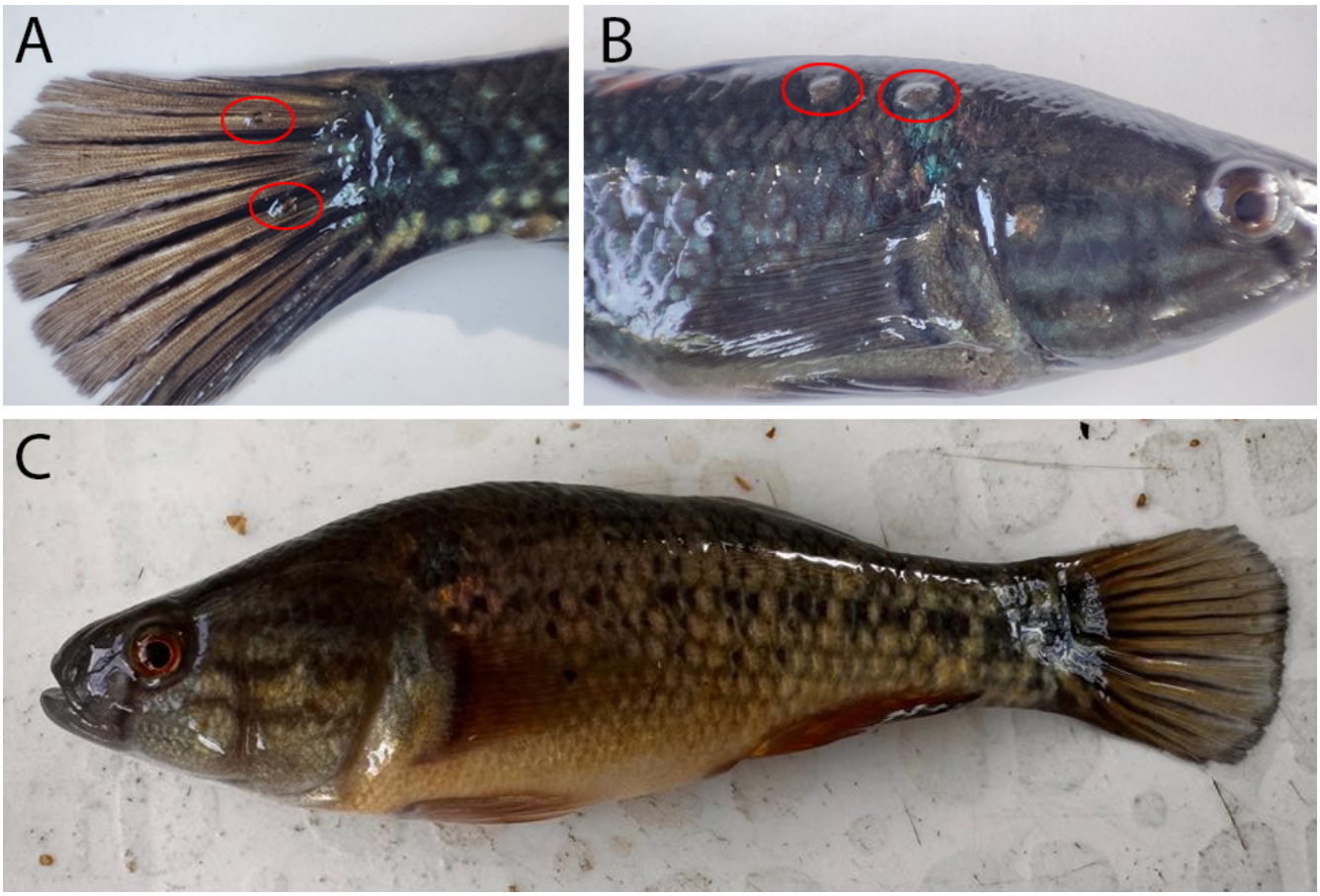

Figure 2. A and B) Specimens of *Dormitator latifrons* with the presence of *Argulus* sp. on the tegument and caudal fin; C) specimen of *D. latifrons* after $KMnO_4$ treatment, showing no presence of *Argulus* sp.

Literature cited

Aalberg, K., Koščová, L., Šmiga, Ľ., Košuth, P., Koščo, J., Oros, M., Barčák, D., & Lazar, P. (2016). A study of fish lice (*Argulus* sp.) infection in freshwater food fish. *Folia Veterinaria, 60*(3), 54-59.

Al Mamun, M. A., Nasren, S., Rathore, S. S., & Ramesh, K. S. (2021). Histopathological studies of pond reared Indian major carp, *Catla catla* infested with *Argulus japonicus* and trial for argulosis treatment. *Punjab University Journal of Zoology, 36*(2), 131-139. https://doi.org/10.17582/journal.pujz/2021.36.2.131.139

Aly, S., Fathi, M., Youssef, E. M., & Mabrok, M. (2020). Trichodinids and monogeneans infestation among Nile tilapia hatcheries in Egypt: Prevalence, therapeutic and prophylactic treatments. *Aquaculture International, 28*, 1459-1471. https://doi.org/10.1007/s10499-020-00537-w

Brahmchari, R. K., Kumari, P., Kumar, S., Sharma, R., Pani Prasad, K., Srivastava, P. P., & Raman, R. P. (2023). Antiparasitic effect of biogenic iron nanoparticles against the fish ectoparasite *Argulus siamensis*: *In vitro* study. *Indian Journal of Fisheries, 70*(3), 107-115. https://doi.org/10.21077/ijf.2023.70.3.132524-14

Cardoso, S. U., Pazdiora, B. R. C. N., Pazdiora, R. D., Oliveira, L. da S. C., Takemoto, R. M., & Souza, R. H. B. de. (2020). Avaliação in vitro de quimioterápicos e fitoterápicos no controle de *Argulus* sp. *Brazilian Journal of Development, 6*(2), 5797-5808. https://doi.org/10.34117/bjdv6n2-036

Chandra, K. (2006). Fish Parasitological Studies in Bangladesh: A Review. *Journal of Agriculture & Rural Development, 4*(1 & 2), 9-18. https://doi.org/10.3329/jard.v4i1.762

Ferreira, J. G., Taylor, N. G. H., Cubillo, A., Lencart-Silva, J., Pastres, R., Bergh, Ø., & Guilder, J. (2021). An integrated model for aquaculture production, pathogen interaction, and environmental effects. *Aquaculture, 536*, 736438. https://doi.org/10.1016/j.aquaculture.2021.736438

França, J. G., Paiva, M. J. T. R., Carvalho, S., Miashiro, L., & Lombardi, J. V. (2011). Toxicity of the therapeutic potassium permanganate to tilapia *Oreochromis niloticus* and to non-target organisms *Ceriodaphnia dubia*

(microcrustacean cladocera) and *Pseudokirchneriella subcapitata* (green microalgae). *Aquaculture, 322-323*, 249-254. https://doi.org/10.1016/j.aquaculture.2011.10.003

Haridevamuthu, B., Raj, D., Arshad, A., & Arockiaraj, J. (2024). Comprehensive review of *Argulus* infestations in aquaculture: Biological impacts and advanced management strategies. *Fish & Shellfish Immunology, 153*, 109851. https://doi.org/10.1016/j.fsi.2024.109851

He, R., Zhu, N., Chen, X., Liang, Q., Yao, G., Tian, Q., Zhou, F., & Ding, X. (2024). Experimental evidence of effective disinfectant to control the transmission of *Micropterus salmoides* rhabdovirus. *Journal of Fish Diseases, 47*(2), e13891. https://doi.org/10.1111/jfd.13891

Misganaw, K., & Getu, A. (2016). Review on major parasitic crustacean in fish. *Fisheries and Aquaculture Journal, 7*, 3. https://doi.org/10.4172/2150-3508.1000175

Noga, E. J. (2010). *Fish disease: Diagnosis and treatment*. John Wiley & Sons.

Piezer, K., Li, L., Jean, Y., Kadudula, A., & Seo, Y. (2021). The application of potassium permanganate to treat cyanobacteria-laden water: A review. *Process Safety and Environmental Protection, 148*, 400-414. https://doi.org/10.1016/j.psep.2020.09.058

Sahoo, P. K., Mishra, M., Mohapatra, A., Parida, S., & Mohanty, J. (2021). Vaccination approach to prevent *Argulus siamensis* infection-success, challenges and preparedness. *Fish and Shellfish Immunology Reports, 2*, 100023. https://doi.org/10.1016/j.fsirep.2021.100023

Sahoo, P. K., Mohanty, J., Garnayak, S. K., Mohanty, B. R., Kar, B., Prasanth, H., & Jena, J. K. (2013). Estimation of loss due to argulosis in carp culture ponds in India. *Indian Journal of Fisheries, 60*(2), 99-102.

Thakur, K., Sharma, A., Sharma, D., Brar, B., Choudhary, K., Sharma, A. K., Mahajan, D., Kumar, R., Kumar, S., & Kumar, R. (2023). An insight into the interaction between *Argulus siamensis* and *Labeo rohita* offers future therapeutic strategy to combat argulosis. *Aquaculture International, 31*(3), 1607-1621. https://doi.org/10.1007/s10499-022-01043-x

Vega-Villasante, F., Cueto-Cortes, L., Basto-Rosales, M. E. R., Badillo-Zapata, D., Chong-Carrillo, O., Ruiz-González, L. E., Ríos-González, K. G., Vargas-Ceballos, M. A., Galavíz-Parada, J. D., & Montoya-Martínez, C. E. (2017). Occurrence of *Argulus* sp. in *Dormitator latifrons* culture: prevalence, mortality and treatment. *Revista Bio Ciencias, 4*(6), 04.06.05. https://doi.org/10.15741/revbio.04.06.05

Walker, P. D., Flik, G., & Bonga, S. E. (2004). The biology of parasites from the genus *Argulus* and a review of the interactions with its host. *Symposia of the Society for Experimental Biology, 55*, 107-129.

Yildiz, K., & Kumantas, A. (2002). *Argulus* foliaceus infection in a goldfish (*Carassius auratus*). *Israel Journal of Veterinary Medicine, 57*(3), 118-120.