Utilization of the tropical almond tree leaves in aquaculture

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Tropical almond tree (*Terminalia catappa*), also known in the Philippines as "*talisay*" is a large tropical tree in the Combretaceae (leadwood tree) family that grows mainly in tropical areas of Asia. The tree grows from 10 m to 25 m high and has horizontal whorls of branches with shiny and ovate leaves, 10-25 cm long, and tapering below to a narrow and heart-shaped base with expanded rounded apex. "*Talisay*" fruit is smooth and ellipsoid, 3-6 cm long, and prominently bi-ridged or keeled down to the sides, with fibrous and fleshy pericarp and hard endocarp. Studies have indicated that the leaves of "*talisay*" are rich in tannins and a host of organic compounds that help in conditioning the culture water resulting in improved survival, growth, and health of cultured aquatic species.

"*Talisay*" at SEAFDEC Aquaculture Department

This is a daily early morning scene at the SEAFDEC Aquaculture Department (SEAFDEC/AQD) in Tigbauan, Iloilo, Philippines. Broad red leaves litter the driveway of the SEAFDEC/AQD premises, especially during the dry season. In previous months, the leaves were a brilliant green before turning into shades of yellow, orange and red (**Figure 1**), and falling away from the tall "*talisay*" trees lined up along the roads leading to the SEAFDEC/AQD buildings and research facilities. Groundsmen armed with leaf blowers and broomsticks promptly clean the driveway early each morning, gathering the leaves before dumping them far from sight.

Figure 1. Green "talisay" leaves with young fruits *(above)*, and various shades of "*talisay*" leaves *(left)*

Not too many people know that these dried tropical almond tree leaves scattered around SEAFDEC/AQD's premises hold almost magical properties that can solve fundamental problems in the aquaculture industry. Being rich in organic compounds, these leaves could be used to condition the culture water resulting in improved survival, growth, and health of cultured species.

Utilization of "*talisay*" leaves in aquaculture

Recently, SEAFDEC/AQD Scientist *Dr. Frolan Aya* demonstrated that simply littering hatchery tanks with "*talisay*" leaves significantly improves the survival of the larvae of "*ayungin*" or silver therapon (*Leiopotherapon plumbeus*). In his experiment, *Dr. Aya* observed that the "*talisay*" leaves, which were simply laid and allowed to decompose in the culture tanks, resulted in a 48% survival of *ayungin* larvae (**Figure 2**). Meanwhile, those without the leaf substrate only achieved 27% survival rate.

Figure 2. Silver therapon or "ayungin" (*Leiopotherapon plumbeus*) larvae
Source: Aya (2019)

In their recent study, Aya *et al*. (2019) supposed that the presence of the "*talisay*" leaf litter allowed small organisms, such as zooplankton and insect larvae, to colonize the leaf surfaces. These organisms soon became food for the *ayungin* larvae. It might have also been possible that the accumulation of leaves at the tank bottom reduces water motion and allows the larvae to conserve their energy instead of going against the flow of current. The darkening of the rearing water caused by the decomposing leaves could have also provided a good background or contrast for the larvae to efficiently capture its prey, thus contributing to better feeding success and consequently improve the larval survival significantly. Previous studies have also shown that the mere presence of the "*talisay*" leaf litter in culture tanks presents some advantages to improve fish survival from fingerlings to commercial sizes (**Figure 3**).

Figure 3. Marketable size of silver therapon or "ayungin" (*Leiopotherapon plumbeus*)
Source: Aya (2019)

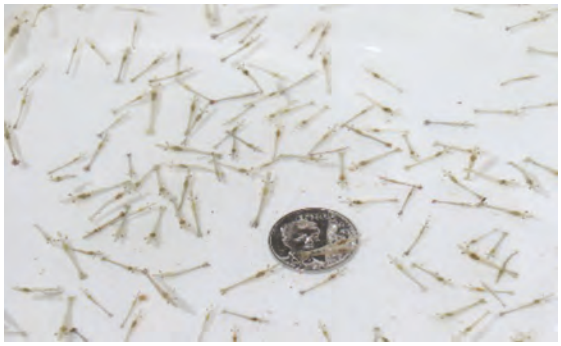

Figure 4. Post-larvae of *Penaeus monodon*

Furthermore, other studies using only extracts of the "*talisay*" leaf have also shown significant improvements in the survival of fish as well as of tiger shrimp (*Penaeus mondon*). Mhd Ikhwanuddin *et al*. (2014) determined the effectiveness of different concentrations of *Terminalia catappa* leaves extract on the survival and growth of the post-larvae of black tiger shrimp *Penaeus monodon* (**Figure 4**). While establishing the concentration of *T. catappa* leaves extracts that has positive effect on the survival and growth performance of *P. monodon* post-larvae, Mhd Ikhwanuddin *et al*. (2014) also suggested that higher concentrations could be toxic to the shrimp larvae that possibly result in high mortality.

Tannin present in the aqueous extract of the leaves of the tropical almond tree could also enhance water quality in culture tanks by reducing the pH and total ammonia nitrogen (TAN) levels, as well as removing the turbidity in water (Bryan, 2017), proving that this plant-based coagulant could be used as water treatment agents in culture tanks. Some studies have also shown that the beneficial organic compounds in *T. catappa* leaves extracts have antimicrobial and antifungal properties. Nevertheless, in the study of Bryan (2017), he observed that *T. catappa* leaf extract had no observable anti-bacterial effect on the water. Babayi *et al*. (2004) however have shown that the methanolic extracts of the *T. catappa* leaf inhabited the growth of Bacillus subtilis and Staphylococcus aureus but had no inhibitory effects on Pseudomonas aeruginosa, Salmonella typhi and Escherichia coli. In another study, Ko *et al*. (2002) found that the extracts of *T. catappa* leaves possessed potent antioxidative and scavenging activities that increase as the leaf matures.

In Thailand, the leaves of *T. catappa* have been used as alternative to chemicals and antibiotics in the culture of tilapia (Chitmanat *et al*., 2005), where the results showed that the ectoparasite *Trichodina* was eradicated from tilapia (**Figure 5**) at 800 ppm concentration of ground leaves while the growth of *Aeromonas hydrophila* was also inhibited at a concentration of 0.5 mg/ml leaves. The extracts were also observed to reduce the fungal infection in tilapia eggs. However, research on the toxicity of leaf extracts on tilapia and the isolation of the active ingredients of the leaves for fish pathogen treatment is still underway. Meanwhile, unpublished data at SEAFDEC/AQD show that the effect of *T. catappa* crude ethanolic extracts on the survival of mangrove crabs mirrored that of antibiotics at the zoea 5 and crab instar 1 stages. This further supports the possible replacement of antibiotics with this natural product.

The effects of *T. catappa* leaf extract on breeding activity of Siamese gourami (Trichogaster pectoralis) also known as snakeskin gourami (**Figure 6**), were determined by Lee *et al*. (2016) by controlling the water pH using the extracts from *T. catappa* leaves. The results indicated that after exposing the fish to various pH using the extracts, the best environment to breed the Siamese gourami was at pH 6.5. Such findings could help the fish farmers in breeding the fish instead of harvesting the seeds of the fish from the wild for their culture activities.

Figure 5. Tilapia, *Oreochromis niloticus*
Source: SEAFDEC/AQD Archive

Figure 6. Siamese gourami, *Trichogaster pectoralis*
Source: FAO

In the breeding of ornamental fishes, the extracts of *T. catappa* leaves have also proven to be useful, especially in eliminating the external parasites such as *Gyrodactylus* sp. and *Dactylogyrus* sp. from goldfish (*Carassius auratus*). This would help the aquarium industry considering that goldfish (**Figure 7**), which is a very popular ornamental fish is often affected by these ectoparasites. In the *Aeromonas hydrophila* infection in ornamental fishes, Jacob *et al*. (2018) had established that plant extracts that are known for their anti-microbial properties could serve as potential alternative therapeutics to treat bacterial septicemia associated with *A. hydrophila* in fish, instead of using antibiotics. Among the plant extracts used was from the leaves of *T. catappa*.

For the culturists of betta fish or the Siamese fighting fish (*Betta splendens*) which is a very popular ornamental fish in the aquarium trade, *T. catappa* is a miracle tree. This is because of its role in healing fungal infections as well as lowering the pH and treating hardness of the culture water for this ornamental fish. In the aquarium industry in Thailand, the use of extracts from *T. catappa* is very popular among

Figure 7. Goldfish, *Carassius auratus*
Source: Public Domain

Figure 8. Betta fish bred in Thailand
Source: Sermwatanakul, 2019

the betta breeders as it also helps them in creating vibrant colors in betta fish (**Figure 8**) as well as in increasing their spawning capacity.

In 2008, a study was conducted by researchers from the Faculty of Veterinary Medicine of Khon Khaen University in Thailand to verify the claims of betta breeders in Thailand on the antibacterial properties of *T. catappa*. In their study, Chansue *et al*. (2008) exposed three species of the most popular ornamental fishes: guppy fish (*Poecilia reticulate*), fancy carp (*Cyprinus carpio*), and Siamese fighting fish (*Betta splendens*) to the water extracts from dried leaves of *T. catappa* for more than 14 days. The results confirmed the findings of Chansue and Assawawongkasem (2008) that the extracts have antibacterial properties addressing the concerns on chemical residues and antibiotic resistance in ornamental fish culture.

Way Forward

Based on the abovementioned findings, placing dried leaves of *Terminalia catappa* in culture tanks could provide the physical benefit of a leaf litter substrate as well as the leaching of desirable organic chemicals to the rearing water. While the method seems simple, more studies are still needed, especially on new applications of the *T. catappa*. Meanwhile, extracts from the dried leaves of *T. catappa* have also provided antibacterial and antifungal benefits. Nonetheless, more studies on this aspect would be necessary, especially in determining the levels of toxicity of the extracts on the cultured organisms.

As the use of natural products are preferable to chemical and antibiotic interventions to improve the health of cultured species, perhaps, soon, the broad red leaves littering the SEAFDEC/AQD driveway will be no more. They will all be stashed away in the hatcheries and laboratories, no longer neglected, because of their almost magical properties.

References

Aya, F.A. (2019). Towards reviving the production of Philippine native aquatic species. ***In***: Fish for the People, Vol. 17 No. 3. Southeast Asian Fisheries Development Center, Bangkok, Thailand; XXX

Aya, F.A., Nillasca, V.S.N., Sayco, M.J.P., & Garcia, L.M.B. (2019). Improved survival, prey selectivity and diel feeding cycle of silver therapon *Leiopotherapon plumbeus* (Perciformes: Terapontidae) larvae reared in tanks with substrate. Ichthyological Research 66:239–248

Babayi, H., Kolo I., Okogun J. I., & Ijah U. J. J. (2004). The antimicrobial activities of methanolic extracts of *Eucalyptus camaldulensis* and *Terminalia catappa* against some pathogenic microorganisms. Biokemistry 16(2):106-111

Bryan, M.N. (2017). *Terminalia catappa* (Talisay) leaves for preliminary surface water treatment: an eco-friendly approach. Nat Prod Chem Res 5: 249. doi: 10.4172/2329-6836.1000249

Chansue, N. & Assawawongkasem, N. (2008). The in vitro antibacterial activity and ornamental fish toxicity of the water extract of Indian almond leaves (*Terminalia catappa* Linn.). KKU Veterinary Journal ,18 (1): 25-30

Chansue, N., Mataderm, T., & Suilasuta, A. (2004). Preliminary study of effects of dried Indian almond *Terminalia catappa* leaf on ultrastuctural morphology of scale in Siamese fighting fish (*Betta splendens*). Proceedings of Thai Herbal: opportunities and alternative way for agriculture animal industries. Bangkok, Thailand, January 15-16, pp. 140-144

Chitmanat, C., Tongdonmuan, K., Khanom, P., Pachontis, P., & Nunsong, W. (2005). Antiparasitic, antibacterial, and antifungal activities derived from a *Terminalia catappa* solution against some tilapia (*Oreochromis niloticus*) pathogens. Acta Hort. (ISHS) 678:179-182 *http://www.actahort.org/books/678/678_25.htm*

Jacob, J.P., Senan, S.C., Das, N., & Jacob, V. (2018). Potential useful application of indigenous extracts in ornamental fishes affecting *Aeromonas hydrophi* infection. J Microbiol Pathol 2018, Vol 2(2): 113

Ko, T.F., Weng, Y.M., Robin, Y., & Chiou, Y. (2002). Squalene content and antioxidant activity of *Terminalia catappa* leaves and seeds. *J. Agric. Food Chem*. 2002, 50, 19, 5343-5348

Lee, S.W., Farhan, R. Wee, W., Wan Zahari, M., & Co, I. (2016). The effects of tropical almond *Terminalia catappa* L., leaf extract on breeding activity of Siamese gourami, *Trichogaster pectoralis*. International Journal of Fisheries and Aquatic Studies, Vol. 4, No. 4 Part F

Mhd Ikhwanuddin, Moh, J. H. Z., Hidayah, M., Noor-Hidayati, A. B., Aina-Lyana, N. M. A., & Abu, S. N. (2014). Effect of Indian almond, *Terminalia catappa* leaves water extract on the survival rate and growth performance of black tiger shrimp, *Penaeus monodon* post larvae. AACL Bioflux, 2014, Volume 7, No. 2

Sermwatanakul, A. (2019). Capacitating the local farmers to enhance global marketing of Thailand's National Aquatic animal, the Siamese Fighting Fish. ***In***: Fish for the People. Vol. 17 No. 2. Southeast Asian Fisheries Development Center, Bangkok, Thailand; pp 42-48

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