International Journal of Environment and Climate Change

Volume 13, Issue 12, Page 192-197, 2023; Article no.IJECC.105049
ISSN: 2581-8627
(Past name: British Journal of Environment & Climate Change, Past ISSN: 2231–4784)

Exploring the Therapeutic and Nutritional Significance of Bay Laurel (*Laurus nobilis*) as a Feed Additive in Aquaculture

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJECC/2023/v13i123675

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/105049

Review Article

Received: 13/08/2023
Accepted: 20/10/2023
Published: 18/12/2023

ABSTRACT

The exploration of medicinal plants as natural and benign compounds in aquaculture presents a promising alternative to conventional antibiotics and immune prophylactics. In the domain of aquaculture, these plants serve dual roles as both chemotherapeutics and feed additives. Many plants and their derivatives contain an array of bioactive compounds, such as phenolic,

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polyphenolic, alkaloid, quinone, terpenoid, lectin, and polypeptide compounds, showcasing their effectiveness as alternatives to antibiotics, chemicals, vaccines, and synthetic compounds. Extensive research highlights the positive impact of incorporating herbs into fish diets, contributing to enhanced growth and disease resistance.

The incorporation of herbs and herbal products into fish diets not only proves cost-effective but also aligns with environmental sustainability, exhibiting minimal side effects on both fish and consumers. Plant extracts are recognized for their diverse benefits, including growth promotion, appetite stimulation, tonicity enhancement, immunostimulation, facilitation of cultured species maturation, and properties such as stress reduction, sexual stimulation, and antipathogenic effects in fish.

This comprehensive review focuses on the significant role of bay laurel (*Laurus nobilis*) in aquaculture, serving as a growth promoter, immunostimulant, and antioxidant. Bay laurel emerges as a medicinal herbal plant, offering a viable alternative to antibiotics with a multifaceted impact on aquaculture production and development. The review delves into the mode of action through which bay laurel enhances various aspects of aquaculture, emphasizing its potential as a valuable asset in sustainable and health-conscious fish farming practices. By exploring the diverse bioactive compounds present in bay laurel, this review contributes to a deeper understanding of its applications and implications in the ever-evolving landscape of aquaculture.

Keywords: Bay laurel; growth promoter; immunostimulant; antioxidant; aquaculture.

1. INTRODUCTION

“Numerous studies have consistently demonstrated the positive impact of incorporating herbs into fish diets, revealing improvements in both growth and the overall health of fish. The overuse of antibiotics, hormones, and synthetic drugs in aquaculture to manage diseases and enhance fish growth has led to the emergence of drug-resistant bacteria and the production of harmful toxins detrimental to the environment and human health” [1]. “As a response to these concerns, there is a growing focus on herbal therapy as a promising, environmentally friendly, and sustainable alternative to chemotherapeutic drugs, aiming to achieve the goal of "green aquaculture" by strengthening fish immune systems” [2,3].

“Herbal extracts, rich in phytochemicals, have garnered significant attention as accessible, cost-effective, and environmentally safe alternatives to traditional chemotherapeutic agents” [4]. “Over the past decade, numerous studies have evaluated a diverse range of herbal extracts on farmed fish species, revealing promising benefits attributed to their bioactive constituents, including essential oils, phytoandrogens, triterpenoids, alkaloids, saponins, phenols, flavonoids, and polysaccharides, among others” [3].

“Herbal extracts, such as those derived from the bay laurel, *Laurus nobilis* (Linnaeus), have gained prominence in aquaculture. Also known as laurel, sweet bay, true laurel, Grecian laurel, Roman laurel, noble laurel, daphne, bay tree, or laurel tree, *L. nobilis* belongs to the Lauraceae family. This evergreen plant, either a multi-branched shrub or a tree reaching up to 10 meters in height, exhibits smooth bark with an olive green to black color. Characterized by dark green, lanceolate leaves, approximately 10 cm long, alternately arranged along the branches, *L. nobilis* is native to the Southern Mediterranean region, the subtropics and tropics of Eastern Asia, South and North America, the Balkans, and Asia Minor” [5].

Within the genus Laurus, two traditional species are identified: *Laurus azorica and L. nobilis.* Despite variations in common names such as bay laurel, bay rum tree, or simply bay (*Pimentaracemosa*), *L. nobilis* is internationally recognized as bay leaf or sweet bay in English and waraqghaar in Arabic. The genus Laurus encompasses a diverse range of 24,00 to 25,00 species and varieties. The extensive exploration of *L.nobilis* and its potential applications in aquaculture aligns with the broader movement toward sustainable and eco-friendly practices within the industry. This review aims to delve into the multifaceted benefits of bay laurel, with a specific focus on its role as a growth promoter, immunostimulant, and antioxidant in the context of aquaculture, contributing to the advancement of "green aquaculture" objectives.

2. UNLOCKING THE POTENTIAL OF BAY LAUREL IN POULTRY AND AQUACULTURE

“The integration of herbal extract (EOM-Heryumix) alongside bay laurel has

demonstrated remarkable benefits, particularly in enhancing egg production and egg weight in both white and brown laying hens", as noted by Bozkurt et al. [6]. Alcicek et al. [7] further emphasized "the growth-enhancing properties of the essential oil combination (EOC) derived from laurel leaf oil in broiler production". In the context of rainbow trout diets, Cagıltay et al. [8] found "a positive correlation between the concentration of bay leaf in the diet and elevated levels of crude protein and crude lipid". However, Bilen and Bilen [9] reported "insignificant impacts on the growth performance and feed efficiency of rainbow trout, revealing a need for further exploration in this domain. Despite extensive research on the effects of bay laurel on fish meat composition and the immune system, limited information exists on its utilization in fish growth diets".

Beyond its applications in poultry and aquaculture, bay laurel demonstrates a bacteriostatic effect with notable benefits in the realm of seafood. Erkan et al. [10] observed that "hot smoked rainbow trout fillets treated with bay laurel essential oil (EO) exhibited improved microbiological quality and extended shelf life". "Furthermore, bay laurel EO showcased its prowess in minimizing spoilage bacterial growth and lipid oxidation in fresh bluefish and sea bream, thereby contributing to prolonged shelf life" [11,12]. However, it's important to note that the introduction of bay laurel EO in sea bream meat may impact liquid holding capacity due to the initiation of early proteolysis [11].

3. EXPLORING THE GROWTH-PROMOTING POTENTIAL OF BAY LAUREL EXTRACT IN AQUACULTURE

In a study conducted by Turan et al. [13], "the impact of bay laurel extract on the growth of *Clarias gariepinus* was evaluated". "The results demonstrated the effectiveness of bay laurel extract as a feed additive in promoting the growth of *C. gariepinus*. Catfish fed with bay laurel extract-supplemented diets exhibited a significant increase in weight gain compared to the control groups" [13]. "Notably, among the bay laurel extract-supplemented groups, those receiving a diet with 1.5% bay laurel extract showed significantly higher growth than fish in the 0.5%, 1%, and control groups" [13].

Majid et al. [14] explored "the use of bay laurel (*L. nobilis*) extract as a prebiotic on the growth and food conversion of common carp (*Cyprinus carpio*). The study revealed that the highest daily growth rate (0.099 g/day) and specific growth rate (0.975 %/day) were achieved in fish fed with a diet containing 2% bay laurel extract, surpassing the growth observed in fish fed with 1%, 3%, and control groups".

Bozkurt et al. [6] reported that "the dietary addition of a herbal essential oil mixture (EOM) containing laurel leaf oil served as a viable alternative to antibiotics growth promoters (AGP) in layer hen nutrition". Similarly, Alcicek et al. [7] highlighted "the potential of an essential oil combination (EOC) containing laurel leaf oil (*L.nobilis*) as a growth promoter in broiler production".

Cristea et al. [15] suggested that "various types of feed additives enhance the digestibility and utilization efficiency of nutrients in aquaculture". "Protein content in bay laurel extract-supplemented groups was significantly higher than that in the control group" [13]. Additionally, Cagıltay et al. [8] reported that "an increase in the concentration of bay leaf (*L.nobilis*) in feed correlated with elevated amounts of crude protein and crude lipid in rainbow trout".

"Furthermore, dietary supplementation of *Elephantopus scaber* at 5g/kg significantly improved weight gain, survivability, and specific growth rate (SGR) in Nile tilapia while decreasing the feed conversion ratio (FCR)" [16]. "The Chinese herbal medicine mixture (CHMM) demonstrated a significant improvement in Japanese sea bass growth performance in the 20g/kg CHMM group" [17].

4. EVALUATING IMMUNOSTIMULANT PROPERTIES

To assess the immunostimulant effects of laurel powder, rainbow trout were subjected to dietary intake in a carefully designed study. After a 14-day adaptation period on a control diet, three groups of rainbow trout were introduced to experimental diets containing 0.5% and 1% laurel leaf powder for a subsequent 21-day period. Following this feeding phase, the fish were reverted to the control diet. Non-specific immunity parameters, including extracellular and intracellular respiratory burst activities, phagocytosis in blood leukocytes, lysozyme levels, and total plasma protein levels, were evaluated after the 21-day experimental feeding period. Subsequent assessments were

conducted 42 and 63 days later. Contrary to expectations, *L.nobilis* did not exhibit immunostimulant properties in this study.

However, the incorporation of Bay laurel powder into diets at rates of 0.5% and 1% led to increased phagocytic activity in *Oncorhynchus mykiss* [18]. “Serum lysozyme activity showed no significant differences in groups fed with laurel leaf powder-supplemented diets throughout the research period. Total serum protein levels also demonstrated no significant differences across all groups. While extracellular oxidative radical production did not exhibit effects on day 21 compared to the control group, on day 42, the extracellular activity of the laurel 0.5% group was significantly higher than that of the laurel 1% and control groups. Phagocytosis of blood leukocytes increased in all groups, with the most pronounced increase observed in the groups fed with 0.5% and 1% laurel on the 21st day” [18].

5. EXPLORING ANTIOXIDANT POTENTIAL

“The investigation into antioxidant activity encompassed a comprehensive analysis, evaluating reducing power, free radical scavenging, superoxide anion radical scavenging, hydrogen peroxide scavenging, and metal chelating activities of both turmeric and laurel aqueous extracts. In linoleic acid emulsion, both extracts exhibited robust total antioxidant activity. The hydrophilic extracts of turmeric and bay laurel demonstrated potent capabilities in suppressing atherosclerosis. Their strong antioxidant potential was manifested through the prevention of apolipoprotein A-I glycation, inhibition of low-density lipoprotein (LDL) phagocytosis, and the impediment of cholesteryl ester transfer protein (CETP) in a zebra fish model conducted” by Seori Jin et al. (2011).

Moreover, the consumption of turmeric and laurel extracts showcased hypolipidemic and antioxidant activities in a hypercholesterolemia zebra fish model, as reported by Seori Jin et al. (2011). The essential oils of *L.nobilis*, *Zingiber officinale*, and *Anethumgraveolens* were identified as effective natural preservatives for fish food, attributed to their antioxidant and antibacterial activities [19]. Notably, the combination of vacuum packing and 2% laurel essential oil exhibited remarkable efficacy in delaying microbial spoilage in rainbow trout fillets, extending their shelf-life by approximately 4 days [20].

6. FUTURE RESEARCH PROSPECTUS

In the realm of aquaculture, future research endeavors should focus on elucidating the dietary impact of bay laurel within commercially important other fish diets, aiming to reconcile conflicting findings reported in existing studies, such as those by Bilen and Bilen [9]. A systematic investigation is warranted, encompassing controlled experiments that vary concentrations of bay laurel within the diet, with a keen focus on growth parameters. This line of inquiry seeks to provide a clearer understanding of how bay laurel influences the growth dynamics of rainbow trout [21,22]

Another crucial avenue for exploration involves delving into the immunostimulant properties of bay laurel across diverse conditions and concentrations. By conducting comprehensive studies, researchers can acquire a holistic understanding of how bay laurel interacts with fish immune systems. This exploration is vital in uncovering the nuanced effects of bay laurel and its potential role in bolstering the immune responses of aquatic species [23].

The optimization of herbal extract combinations presents a promising research direction to maximize growth promotion and immune stimulation in aquaculture. Investigating synergistic effects arising from the combination of bay laurel with other herbal extracts is paramount. This research should explore various ratios and concentrations to identify optimal formulations that amplify the positive impacts of herbal extracts, thereby contributing to more effective and sustainable aquaculture practices [24,25].

Advancing the field of aquaculture requires further exploration into sustainable preservation techniques involving bay laurel and other herbal extracts. Research in this domain should target different fish species, aiming to enhance shelf life while maintaining product quality. By evaluating diverse preservation methods and concentrations of bay laurel, researchers can pinpoint eco-friendly approaches that align with the principles of sustainable aquaculture [26,27].

Conducting comprehensive studies to assess the ecological impact of incorporating bay laurel into aquaculture practices is imperative for ensuring the overall sustainability of these endeavors. This research should extend beyond immediate impacts and consider broader ecosystem

dynamics, water quality changes, and other ecological factors. Such an assessment is pivotal for developing responsible aquaculture practices that minimize adverse ecological effects, aligning with the overarching goal of sustainability in the industry.

7. CONCLUSION

In conclusion, the integration of herbal medicinal plants, with a spotlight on bay laurel, emerges as a promising and eco-friendly alternative to antibiotics in aquaculture. Bay laurel's multifaceted benefits, encompassing its roles as a growth promoter, immunostimulant, and antioxidant agent, underscore its potential to revolutionize sustainable practices within the industry. The positive outcomes observed in various studies, spanning enhanced growth rates, strengthened immune responses, and antioxidant properties, affirm bay laurel's efficacy in fostering healthier and more resilient fish populations. This botanical approach not only addresses concerns related to the overuse of antibiotics but also aligns with the broader ethos of environmentally conscious and sustainable aquaculture.

CONFERENCE DISCLAIMER

Some part of this manuscript was previously presented and published in the conference: Strategies and Challenges in Agricultural and Life Science for Food Security and Sustainable Environment (SCALFE-2023), Himachal Pradesh University, Summer Hill, Shimla, HP, India, April 28-30, 2023,Web Link of the proceeding: https://www.shobhituniversity.ac.in/pdf/Souvenir-Abstract%20Book-Shimla-HPU-SCALFE-2023.pdf

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/105049