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# Effectiveness of Cinnamon (*Cinnamomum burmannii*) Leaf Extract on Growth and Meat Quality of Farmed Fish: A Review

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**ABSTRACT**

Aquaculture continues to expand globally, requiring natural and sustainable feed additives to enhance fish growth and meat quality. Cinnamon (*Cinnamomum burmannii*) leaf extract contains diverse bioactive compounds, including cinnamaldehyde, flavonoids, polyphenols, and terpenoids, which possess antioxidant, antimicrobial, and growth-promoting properties. This review aims to summarize scientific evidence on the effectiveness of cinnamon leaf extract in improving growth performance and meat quality of farmed fish. A systematic literature review was conducted by analyzing 41 scientific publications obtained from Google Scholar, ProQuest, and Elsevier. The reviewed studies consistently showed that supplementation of cinnamon leaf extract or powder at doses ranging from 0.25–1% in fish feed enhances growth parameters such as Specific Growth Rate, feed efficiency, protein retention, and biomass in species including barramundi, Nile tilapia, common carp, and striped catfish. In addition, the extract significantly improves meat quality by reducing body and meat fat content, enhancing texture, increasing protein levels, and improving sensory attributes such as taste and fillet color. These improvements are attributed to the metabolic, antioxidant, and lipid-modulating mechanisms of the phytochemicals present in cinnamon leaves. Overall, cinnamon leaf extract demonstrates strong potential as a natural, environmentally friendly feed additive that supports both productivity and product quality in modern aquaculture systems.

## INTRODUCTION

Aquaculture, or the cultivation of aquatic organisms such as fish, shrimp, and shellfish, plays a crucial role in fulfil the growing global demand for animal protein (Affandi & Setyono, 2023, 2024a, 2024b; Muahiddah & Affandi, 2023). The aim is to cultivate aquatic animals under well-controlled conditions to achieve optimal growth and productivity in the shortest

time (Habiba *et al*., 2021). This has led to a growing desire among the public to develop fish farming businesses, addressing growing market demand.

The long cultivation periods for some fish species have drawn concern from fish farmers, leading to the idea of improving feed efficiency and fish growth. High feed efficiency and faster fish growth will benefit farmers in their production processes (Rolin *et al*., 2015). Furthermore, consumers are now demanding aquaculture products with quality and delicious flavors that suit their tastes (Jusadi *et al*., 2016). One ingredient that can be added to fish feed to enhance growth performance and improve fish meat quality is cinnamon (*Cinnamomum burmannii*) leaf extract.

Cinnamon contains several active substances that not only function as antioxidants but also improve fish growth performance. Cinnamon contains polyphenols, cinnamaldehyde, and flavonoids. Flavonoids help promote fish growth through protein biosynthesis, which helps replace damaged cells and build meat (Linayati *et al*., 2025). Cinnamaldehyde can activate insulin-like growth factor-1 (IGF-1), which increases protein and collagen biosynthesis in fish tissues, thereby increasing protein deposition in the fish's body for muscle building. Cinnamaldehyde also increases fish meat fat content, cholesterol, and triglyceride deposition (Setiawati, Jusadi, Laheng, *et al*., 2016). This can improve fish meat quality.

Based on the explanation above, this literature review aims to compile and analyze various scientific findings related to the effectiveness of cinnamon leaf extract in increasing the growth of farmed fish, as well as to evaluate its effect on the quality of farmed fish meat based on published research results. This literature review also focuses on compiling a comprehensive overview of the potential use of cinnamon leaf extract as a natural additive in aquaculture. Therefore, this literature review is expected to provide a scientific basis and direction for further research, especially for researchers who will develop studies related to the potential of this natural ingredient.

## METHODS

### Place and Time

This literature review research was conducted from October to November 2025 in Mataram, West Nusa Tenggara, Indonesia.

### Tools and Materials

Tools and materials used in this literature study research (literature review) include laptop, laptop charger, mouse, scientific articles in soft file.

### Procedurs

Access to relevant information for the preparation of this article was obtained from Google Scholar, Proquest, and Elsevier. The articles used were 39 journals and 2 proceeding. The method used in this article is a systematic literature review. Systematic literature study is a series of activities relating to methods of collecting library data, reading and taking notes, and managing research data objectively, systematically, analytically and critically about the effectiveness of cinnamon leaf extract on growth and meat quality of farmed fish. This literature study analyzes it in detail and in depth in order to obtain objective results regarding the effectiveness of cinnamon leaf extract on growth and meat quality of farmed fish. The data collected and analyzed is secondary data in the form of research results such as books, journals and relevant articles (Affandi & Diamahesa, 2023).

**Data Analysis**

The data analysis technique in this article uses content analysis techniques. Data analysis begins by analyzing research results from the most relevant, relevant, and quite relevant. Researchers then read the abstract of each study to provide an assessment of whether the problems discussed are in accordance with the problems to be solved in this research. Next, note down the important and relevant parts of the research problem and end with drawing conclusions (Affandi & Diniariwisan, 2024).

## RESULTS

**Content and Role of Active Compounds in Cinnamon Leaves**

Cinnamon leaves are a part of the cinnamon plant known to contain various bioactive compounds, detailed in Table 1. Traditionally, these leaves are used as a spice and herbal medicine, but in recent years, their use in aquaculture has begun to be widely studied. With their high phytochemical content, cinnamon leaves are considered strategically valuable as an alternative, environmentally friendly additive in modern fish farming.

Table 1. Content and Role of Active Compounds in Cinnamon Leaves

| Active Compounds | Roles | References |
|---|---|---|
| Geraniol, cinnamaldehyde, coumarin, hexadecanoic acid, methyl ester, eucalyptol, linalool | Antibiotic, antibacterial, antifungal, antimicrobial, antiviral, anti-inflammatory, antioxidant | (Lestari *et al*., 2025) |
| Polyphenols, cinnamaldehyde, flavonoids, tannins, saponins | Antioxidant, growth enhancer, antibacterial | (Linayati *et al*., 2025) |
| Flavonoids, tannins, polyphenols, calcium oxalate | Antioxidant, antibacterial, immunostimulant | (Rolin *et al*., 2025) |
| Cinnamaldehyde, cinnamic acid, cinnamyl alcohol, eugenol, kaempferol, coumarin, benzoic acid, quercetin | Antioxidant, anti-inflammatory | (Chen *et al*., 2025) |
| Alkaloids (isoquinolines), tannins (proanthocyanidins and catechins), flavonoids (quercetin and kaempferol), terpenoids (cineol, terpineol, pinene, cinnamaldehyde, eucalyptol, and eugenol), steroids | Antibacterial, antioxidant, anti-inflammatory, cardioprotective, neuroprotective, immunomodulatory | (Fiana *et al*., 2024) |
| Cinnamaldehyde, monoterpenes, phellandrene, linalool, caryophyllene, hydrocarbons, pinene, benzaldehyde, benzyl benzoate, cinnamyl alcohol, eugenol acetate, cinnamyl acetate, eugenol, methyl eugenol | Antifungal, antimicrobial, antibiofilm, antibacterial, antiviral, anti-inflammatory, antioxidant | (Sudirga *et al*., 2024) |
| Cinnamaldehyde, eugenol, cinnamic acid, cinnamate, | Antibacterial, antimicrobial, antioxidant, antivirulence | (Darmayasa *et al*., 2024) |

| Active Compounds | Roles | References |
|---|---|---|
| alkaloids, steroids, phenolics, saponins, flavonoids | | |
| Alkaloids, flavonoids, saponins, tannins, steroids, phenols | Antibacterial, antioxidant, anti-inflammatory | (Kasmadi *et al*., 2024) |
| Cinnamaldehyde, eugenol | Antioxidant, antibacterial, antimicrobial | (Yitbarek *et al*., 2023) |
| Cis-cinnamaldehyde, trans-cinnamaldehyde, isobornyl acetate, eugenol, cinnamyl acetate, phenolic acids, flavonoids, monoterpenoids, sesquiterpenoids, alcohols, phenols, aldehydes, ketones, esters | Anti-inflammatory, neuroprotective, antioxidant | (Wang *et al*., 2023) |
| Cinnamaldehyde, phenolics, flavonoids, alkaloids, saponins, tannins, polyphenols, triterpenoids | Immunomodulatory, antifungal, antioxidant, anti-inflammatory, antibacterial | (Wulandari & Yuniarti, 2023) |
| E-Cinnamaldehyde, benzyl benzoate, trans-Cinnamyl acetate, β-caryophyllene | Antioxidant, anti-inflammatory, neuroprotective, antifungal, antibacterial, antimicrobial, immunomodulatory | (Mutlu *et al*., 2023) |
| Cinnamaldehyde, eugenol, benzyl benzoate, eugenyl acetate | Antimicrobial, antifungal, antioxidant | (Alvarez-Perez *et al*., 2023) |
| Cinnamyl acetate, cinnamaldehyde, trans-cinnamic acid, eugenol, catechin, epicatechin, kaempferol | Anti-inflammatory, antioxidant | (Abeysekera *et al.*, 2022) |
| Quercetin, rutin, caffeic acid, benzoic acid, kaempferol, trans-cinnamic acid, coumarin, cinnamyl alcohol, p-coumaric acid, eugenol, kaempferol, cinnamaldehyde | Antioxidant, anti-inflammatory | (Huang & Chen, 2022) |
| Alkaloids, flavonoids, phenolic hydroquinone, saponins, tannins | Antioxidant, immunostimulant | (Lutfan *et al*., 2022) |
| Cinnamaldehyde, eugenol | Antioxidant, antimicrobial, antifungal, anti-inflammatory, antipyretic, immunostimulant | (Senevirathne *et al*., 2022) |
| Cinnamaldehyde, cinnamic acid, cinnamyl acetate, eugenol, caryophyllene, caryophyllene oxide, -cubebene, terpineol, coumarin, camphor | Antibacterial, antifungal, antioxidant | (Syarafina *et al*., 2022) |
| Cinnamaldehyde, eugenol | Antimicrobial, antioxidant, antibacterial, bactericidal, virucidal, fungicidal | (Cava-Roda *et al*., 2021) |

| Active Compounds | Roles | References |
|---|---|---|
| Cinnamaldehyde | Antioxidant | (Septiana *et al*., 2021) |
| Eugenol, benzyl benzoate, trans caryophyllene, acetyl eugenol, linalool | Antimicrobial, antifungal, antibiofilm | (Wijesinghe, de Oliveira, *et al*., 2021) |
| Cinnamaldehyde, coumarin, eugenol, linalool, β-caryophyllene, benzyl benzoate | Antibacterial, antibiofilm, antiparasitic, antioxidant, anti-inflammatory, antimicrobial | (Wijesinghe, Feiria, *et al*., 2021) |
| Cinnamaldehyde, eugenol | Antibacterial, antioxidant, anti-inflammatory, antimicrobial, antifungal, neuroprotective | (Kowalska *et al*., 2021) |

**Cinnamon Leaves to Increase the Growth of Farmed Fish**

Cinnamon leaves have been utilized as a natural ingredient with the potential to enhance the growth of farmed fish through their bioactive compounds. The phytochemical compounds in these leaves are known to improve digestive efficiency and enhance nutrient absorption in fish. Therefore, the use of cinnamon leaves as a feed additive is considered an environmentally friendly solution to support the productivity of modern fish farming. Previous research utilizing cinnamon leaves to enhance the growth of farmed fish is summarized and presented in Table 2.

Table 2. Cinnamon Leaves to Increase the Growth of Farmed Fish

| Fish | Method | Results | References |
|---|---|---|---|
| Barramundi (*Lates calcarifer*) | Oral | The results showed that adding cinnamon leaf extract to barramundi feed at a dose of 1 g/100 g of feed increased:<br>1. Biomass growth<br>2. Feed utilization efficiency | (Linayati *et al*., 2025) |
| Nile tilapia (*Oreochromis niloticus*) | Oral | The results obtained were that the addition of cinnamon leaf extract through feed to Nile tilapia with the best dose of 0.25% gr/kg feed could increase the Specific Growth Rate (SGR) and reduce the Feed Conversion Ratio (FCR). | (Rahmawati & Ubaidillah, 2017) |
| Common carp (*Cyprinus carpio*) | Oral | The results showed that adding cinnamon leaf extract to common carp feed at a dose of 0.25% increased:<br>1. Daily growth rate<br>2. Feed efficiency | (Jusadi *et al*., 2016) |
| Striped catfish (*Pangasianodon hypophthalmus*) | Oral | The results showed that adding cinnamon leaf extract to striped catfish feed at a dose of 1% increased:<br>1. Absolute weight | (Setiawati, Jusadi, Laheng, *et al*., 2016) |

| Fish | Method | Results | References |
|---|---|---|---|
| | | 2. Specific growth rate<br>3. Feed efficiency | |
| Striped catfish (*Pangasianodon hypophthalmus*) | Oral | The results showed that adding cinnamon leaf extract to striped catfish feed at a dose of 1 g/kg of feed increased:<br>1. Protein retention<br>2. Feed efficiency | (Rolin *et al*., 2015) |
| Striped catfish (*Pangasianodon hypophthalmus*) | Oral | The results showed that adding cinnamon leaf extract to striped catfish feed at a dose of 1% increased:<br>1. Feed efficiency<br>2. Daily growth rate | (Setiawati *et al*., 2015) |
| Striped catfish (*Pangasius hypopthalmus*) | Oral | The results showed that adding cinnamon leaf extract to striped catfish feed at a dose of 1% increased:<br>1. Daily growth rate<br>2. Feed efficiency<br>3. Protein retention | (Setiawati *et al*., 2014) |

**Cinnamon Leaves to Improve the Meat Quality of Farmed Fish**

Cinnamon leaves are beginning to gain attention as a natural ingredient capable of improving the meat quality of farmed fish through their phytochemical content. The antioxidant and antimicrobial compounds they contain play a role in suppressing oxidative stress and improving metabolism, resulting in fresher, more nutritious meat. Due to its environmentally friendly nature, the addition of cinnamon leaves as a feed additive is considered a sustainable alternative for improving the final quality of fishery products. Previous research utilizing cinnamon leaves to improve the meat quality of farmed fish is summarized and presented in Table 3.

Table 3. Cinnamon Leaves to Improve the Meat Quality of Farmed Fish

| Fish | Method | Results | References |
|---|---|---|---|
| Striped catfish (*Pangasianodon hypophthalmus*) | Oral | The results obtained were that the addition of cinnamon leaf flour through feed to striped catfish could reduce the body fat content of striped catfish by 14.7% and the texture of striped catfish meat fillets became more compact, dense, elastic and the taste of the meat was more preferred, and the color of the striped catfish fillets was whiter. | (Setiawati *et al*., 2017) |
| Common carp (*Cyprinus carpio*) | Oral | The results obtained were that the addition of cinnamon leaf extract to common carp feed at 0.75% and 1% | (Jusadi *et al*., 2016) |

| Fish | Method | Results | References |
|---|---|---|---|
| | | resulted in a denser meat texture and a sweeter taste. | |
| Striped catfish (*Pangasianodon hypophthalmus*) | Oral | The results showed that administering 0.1% cinnamon leaf extract and 1% cinnamon leaf flour reduced body fat by 10-12% and meat fat by 37-50%, resulting in a compact meat texture and white color. However, the cinnamon leaf extract treatment effectively imparted a slightly sweet flavor to the striped catfish. | (Laheng *et al*., 2016) |
| Striped catfish (*Pangasianodon hypophthalmus*) | Oral | The addition of 1 g/kg of cinnamon leaf extract provided optimal results by reducing meat fat, cholesterol, and triglyceride content compared to the control treatment without cinnamon leaf extract. | (Setiawati, Jusadi, Rolin, *et al.*, 2016) |
| Striped catfish (*Pangasianodon hypophthalmus*) | Oral | Fish feed with the addition of 0.5% cinnamon leaf flour given to striped catfish for a period of 40 days showed an increase in the quality of meat texture and protein. | (Setiawati *et al*., 2015) |
| Striped catfish (*Pangasius hypopthalmus*) | Oral | The body fat content of fish decreased by 30% in fish fed with the addition of cinnamon leaves and the texture of the meat appeared somewhat compact. | (Setiawati *et al*., 2014) |

## DISCUSSION

Cinnamons are widely found in subtropical and tropical regions, one of which grows in Indonesia. This cinnamon has a tree shape with a height ranging from 5-15 m, its bark is dark gray with a distinctive smell and its wood is light reddish brown. Single leaves with a stiff texture like leather, alternate arrangement, leaf stalk length 0.5-1.5 cm with 3 leaf veins that grow curved, elongated elliptical shape with a length of 4-14 cm and a width of 1.5-6 cm, pointed tip with a flat edge, the upper surface is smooth green, the lower surface is floury grayish. Young leaves are pale red. The flowers are bisexual or perfect flowers with a yellow color (Sanjiwani *et al*., 2023). Cinnamon is a plant whose bark, branches, and twigs can be used as spices, and is one of Indonesia's export commodities. Cinnamon leaves have been underutilized. Cinnamaldehyde content is 63.61% in cinnamon leaf essential oil. The main active compounds in cinnamon leaf essential oil are L-linalool (34.40%), 1,8-cineole (18.18%), α-pinene (13.96%), β-pinene (9.30%), and benzyl benzoate (4.42%) (Utami *et al*., 2017).

The diversity of bioactive compounds in cinnamon leaves, particularly cinnamaldehyde, eugenol, flavonoids, tannins, and various terpenoid groups, indicates that this plant has great potential as a functional additive to enhance the growth of farmed fish. These compounds have consistently been reported to possess potent antibacterial, anti-inflammatory, and

antioxidant activities (Lestari *et al*., 2025; Linayati *et al*., 2025; Rolin *et al*., 2025). The mechanism of action of these bioactive compounds can improve the physiological health of fish by reducing oxidative stress and protecting against pathogens, allowing the fish's metabolic energy to be more optimally directed towards growth processes, rather than immune responses. Furthermore, compounds such as polyphenols, saponins, and terpenoids also play a role in stimulating the immune system and improving digestive function, ultimately supporting feed utilization efficiency (Darmayasa *et al*., 2024; Fiana *et al*., 2024).

In the context of fish meat quality, antioxidant compounds such as cinnamaldehyde, quercetin, kaempferol, and various phenolic acids have the potential to maintain lipid stability, inhibit oxidation, and maintain post-harvest meat freshness (Chen *et al*., 2025; Huang & Chen, 2022). The antimicrobial activity produced by eugenol, benzyl benzoate, and other monoterpenoids can reduce the risk of microbial contamination and extend the shelf life of fish meat *(Alvarez-Perez et al., 2023; Mutlu et al., 2023). The combination of anti-inflammatory, antibacterial, and antibiofilm properties* of these compounds also contributes to a more stable physiological condition of fish, thus better maintaining meat quality parameters such as texture, color, and fat content (Kowalska *et al*., 2021; Wijesinghe, Feiria, *et al*., 2021). Thus, the evidence compiled from various studies in Table 1 strengthens the conclusion that cinnamon leaf extract is a superior candidate as a natural ingredient to improve the growth and quality of farmed fish meat.

The results summarized in Table 2 show that the addition of cinnamon leaf extract consistently had a positive impact on the growth of various farmed fish species. Feed administration of the extract has been shown to increase important growth parameters such as Specific Growth Rate (SGR), daily growth rate, and biomass, as seen in barramundi (Linayati *et al*., 2025), tilapia (Rahmawati & Ubaidillah, 2017), and common carp (Jusadi *et al*., 2016). This positive effect is thought to be related to the ability of the bioactive compounds in cinnamon leaves to improve metabolic processes and stimulate nutrient utilization efficiency, allowing fish to allocate energy more optimally for growth. Furthermore, the recorded effective dose varied between 0.25% and 1%, or approximately 1 g/kg of feed, demonstrating the flexibility of cinnamon leaf extract application to various types of farmed fish.

In addition to increasing growth rate, cinnamon leaf extract has also been shown to improve feed efficiency and protein retention, two important parameters that contribute to production performance. In striped catfish, for example, several studies have reported increased feed efficiency, protein retention, and absolute weight gain at doses of approximately 1% or 1 g/kg of feed (Rolin *et al*., 2015; Setiawati *et al*., 2014, 2015; Setiawati, Jusadi, Laheng, *et al*., 2016). This increase in feed efficiency indicates that cinnamon leaf extract can support the optimization of the digestion and absorption of nutrients, resulting in more effective conversion of feed into fish body tissue. These findings strengthen the evidence that cinnamon leaf extract has great potential as a natural feed additive that not only increases growth but also supports the sustainability of aquaculture by increasing feed input efficiency.

The findings compiled in Table 3 show that the addition of cinnamon leaves, either in powder or extract form, consistently provides significant improvements in the meat quality of farmed fish, particularly striped catfish. Several studies report a reduction in body and meat fat content of between 10–50%, as well as an improvement in meat texture, making it more compact, elastic, and brighter in color, in striped catfish fed cinnamon leaf flour or extract (Laheng *et al*., 2016; Setiawati *et al*., 2014, 2017). These effects are thought to be due to the presence of bioactive compounds such as cinnamaldehyde, flavonoids, and polyphenols, which suppress lipid accumulation and enhance fat metabolism. Furthermore, some

treatments also improve sensory qualities, such as a more favorable taste and a whiter fillet color, which are important parameters for consumer preference and the market value of fish.

In addition to the fat-reducing effect, the use of cinnamon leaf extract also contributes to improved nutritional value and organoleptic characteristics of the meat. In carp, for example, the addition of cinnamon leaf extract at a dose of 0.75–1% was reported to result in a denser meat texture and a sweeter flavor (Jusadi *et al*., 2016). Another study in striped catfish showed an increase in texture quality and protein content after being fed cinnamon leaf flour for 40 days (Setiawati *et al*., 2015). Furthermore, administering cinnamon leaf extract at a dose of 1 g/kg of feed was shown to significantly reduce cholesterol and triglyceride levels in meat (Setiawati, Jusadi, Rolin, *et al*., 2016). Overall, these results confirm that cinnamon leaves are a potential natural feed additive to improve meat quality by reducing fat components, improving tissue structure, and enhancing the flavor and freshness of farmed fish meat.

## CONCLUSION

Cinnamon (*Cinnamomum burmannii*) leaf extract has great potential as a natural additive in aquaculture due to its bioactive compounds that can improve the growth and quality of farmed fish. Various studies have shown that cinnamon leaf extract effectively improves feed efficiency, growth rate, meat texture, and reduces fat content through antioxidant, antimicrobial, and metabolic-enhancing mechanisms. Overall, the findings in this article confirm that cinnamon leaf is a promising candidate for an environmentally friendly additive to improve the productivity and quality of modern aquaculture products.

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