

EXPLORATION THE POTENTIAL OF GARCINIA COWA (ASAM KANDIS) UTILIZATION THROUGH THE COATING METHOD IN FISH FEED ON THE GROWTH PERFORMANCE OF NILE TILAPIA FINGERLINGS

Eksplorasi Potensi Pemanfaatan Asam Kandis *Garcinia Cowa* dengan Metode Coating pada Pakan Ikan terhadap Performa Pertumbuhan Benih Ikan Nila

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ABSTRACT

Garcinia cowa or commonly known as Asam Kandis in Indonesia, contains several bioactive compounds such as xanthenes, flavonoids, tannins, and hydroxycitric acid (HCA), which are beneficial for health and growth. Owing to these bioactive properties, *G. cowa* shows potential as a natural alternative feed additive to enhance feed efficiency, and fish growth. This study was conducted using a Completely Randomized Design (CRD) with four treatments and three replications. The treatments consisted of *G. cowa* extract supplementation at 0% (Treatment A), 0.5% (Treatment B), 1% (Treatment C), and 1.5% (Treatment D). The parameters measured included specific growth rate, survival rate, and feed conversion ratio. Data were analysed using analysis of variance (ANOVA) ($p < 0.05$), followed by Duncan's Multiple Range Test when significant differences were detected. The results demonstrated that supplementation with 0.5% *G. cowa* extract (Treatment B), applied using the coating method, yielded the best growth performance in Nile tilapia (*Oreochromis niloticus*) fingerlings, with a specific growth rate of 3.37%, feed conversion ratio of 1.30, and survival rate of 60%. These findings suggest that *G. cowa* has promising potential as a natural feed additive in aquaculture production.

Keywords: Asam Kandis, Feed Additive, Growth Performance, Nile Tilapia

ABSTRAK

Tanaman *Garcinia cowa* atau asam kandis memiliki beberapa senyawa bioaktif seperti xanthone, flavonoid, tanin, dan asam hidroksisitat (HCA) yang bermanfaat bagi kesehatan dan pertumbuhan. Kandungan senyawa bioaktif yang terkandung didalamnya menjadikan asam kandis berpotensi untuk dijadikan sebagai alternatif feed aditif alami dengan tujuan untuk meningkatkan efisiensi pakan, dan pertumbuhan ikan. Penelitian dilakukan dengan menggunakan model penelitian Rancangan Acak Lengkap dengan 4 perlakuan dan 3 ulangan.

Perlakuan yang diberikan merupakan penambahan ekstrak asam kandis sebesar 0% (Perlakuan A), 0,5% (Perlakuan B), 1% (Perlakuan C), dan 1,5% (Perlakuan D). Parameter yang diamati berupa laju pertumbuhan harian, tingkat kelangsungan hidup, dan rasio konversi pakan. Analisa data menggunakan statistik uji ragam (Uji Anova) dengan tingkat kepercayaan 95%, apabila terdapat perbedaan yang signifikan maka dilanjutkan dengan Uji Duncan untuk mengetahui nilai antar perbedaan. Hasil penelitian menunjukkan bahwa penambahan 0,5% tepung asam kandis (perlakuan B) pada pakan ikan dengan metode *coating*, memberikan performa terbaik terhadap performa pertumbuhan benih ikan nila dengan nilai laju pertumbuhan harian sebesar 3,37% per hari, rasio konversi pakan sebesar 1,30, dan SR sebesar 60%. Penelitian ini menunjukkan adanya potensi tepung asam kandis sebagai feed aditif alami dalam pakan ikan.

Kata Kunci: Asam Kandis, Feed Aditif, Ikan Nila, Pertumbuhan

INTRODUCTION

Aquaculture is a producer of animal protein with a remarkably significant production growth, reaching 111.95 million tons in 2017, with an annual growth rate of 6.24% since 1994 (Tacon, 2020). Verdegem *et al.*, (2023) explained that there are 13 cultured fish species with production exceeding 1 million tons, contributing 71% of total global aquaculture production, one of which is Nile tilapia (*Oreochromis niloticus*), with a total production of 4.6 million tons per year. Nile tilapia production in Indonesia reached 1,368,542 tons, with a production growth of 4.68% per year from 2019–2023, placing this commodity in second position in aquaculture production in 2023 (KKP, 2025). The increase in Nile tilapia production aligns with government efforts to support the achievement of the Sustainable Development Goals (SDGs) 2030, particularly food security (SDG 2), responsible consumption and production (SDG 12), and life below water conservation (SDG 14). Ichtifa *et al.*, (2019) highlighted several challenges faced by aquaculture farmers, one of which is the inefficiency of feed.

Improving aquaculture efficiency can be achieved by utilizing natural feed additives, which are supplementary feed ingredients aimed at enhancing aquaculture productivity (Andriani *et al.*, 2016). Feed additives function by improving feed performance through enhanced nutrient absorption, stimulation of digestive enzymes, and increased immune responses in fish. Natural plant-based feed additives containing bioactive compounds have been proven to reduce feed conversion ratios, accelerate growth, and enhance fish resistance to environmental stress and pathogens (Doan *et al.*, 2019). *Garcinia* is a genus of plants with biochemical compounds beneficial to health (Hamshekar *et al.*, 2011) and has substantial potential as a natural feed additive. One species of *Garcinia* studied as a natural feed additive is mangosteen (*Garcinia mangostana*), whose peel extract contains xanthenes and flavonoids and has been shown to enhance growth and immune system performance in Nile tilapia (Yostawonkul *et al.*, 2023). Furthermore, other studies demonstrated that supplementation of *Garcinia kola* in feed can improve feed efficiency and resilience in Nile tilapia (Sulem-Yong *et al.*, 2018).

Asam kandis (*Garcinia cowa*) is a species of *Garcinia* widely distributed in Indonesia, particularly in Sumatra and Kalimantan, containing bioactive components similar to other natural materials previously studied, such as xanthenes, flavonoids, tannins, and hydroxycitric acid (HCA) (Hamshekar *et al.*, 2011; Ritthiwigrom *et al.*, 2013; Oktafirmanda *et al.*, 2022). These compounds have the potential to enhance growth, feed efficiency, and fish resistance to infections. Research on the use of asam kandis in fish feed remains very limited; however, its bioactive content resembles that of mangosteen peel and indicates that compounds in this plant may improve feed efficiency and disease resistance in fish (Yostawonkul *et al.*, 2023).

Therefore, further research is required to explore the potential of asam kandis as a feed additive for Nile tilapia.

This study aims to evaluate the effectiveness of adding asam kandis extract to Nile tilapia feed on growth and feed efficiency. The results are expected to provide preliminary information regarding the potential of environmentally friendly and sustainable natural feed additives for the aquaculture industry in Indonesia.

METHODS

Time and Place

This study was conducted at the Wet Laboratory, PSDKU Universitas Brawijaya, Kota Kediri, from June to July 2025. Nile tilapia juveniles (average weight 3.8 ± 0.47 g) were acclimatized for 7 days in ponds and subsequently fed commercial feed *ad libitum*. After 7 days, 10 fish were randomly transferred into maintenance containers with 15 L of water, equipped with aeration and heaters. A completely randomized design (CRD) with 4 treatments and 3 replications was employed to evaluate the feed over a 21-day period. The treatments consisted of the addition of asam kandis powder extract at 0% (treatment A), 0.5% (treatment B), 1% (treatment C), and 1.5% (treatment D). The selection of these treatment levels was based on previous research articles and reviews on the use of plant-based feed additives in fish diets, indicating that doses below 2% yield optimal growth performance (Hoseini *et al.*, 2021; Kuebutornye *et al.*, 2023; Adineh *et al.*, 2024). The experimental fish were fed the test diet at 5% of their biomass, administered three times daily.

Tools and materials

The tools used in this study included an aquarium, a scoop, a 0.01 g digital scale, a DO meter, a thermometer, a millimeter block, a pH meter, an aerator set, a heater, a sprayer, an Erlenmeyer flask, and a hotplate. The materials used in the study included commercial feed (30% protein), tilapia seeds, an ammonia test kit, kandis acid, and distilled water.

Research Procedures

Asam kandis was dried until its moisture content reached 10–15%, after which it was ground into powder using a blender. The powder was then weighed according to the designated treatment levels for the experimental feed, which consisted of 200 g of feed with 1, 2, and 3 g of asam kandis powder. The asam kandis powder was extracted using 10 mL of distilled water and heated on a hot plate at 95 °C for 10 minutes, then allowed to cool to room temperature (Thiankham *et al.*, 2024). Following extraction, the resulting extract was incorporated into commercial feed using a sprayer and subsequently dried.

Research Parameters

Daily Growth Rate

Daily growth rate (DGR) is the weight gain per unit of time expressed as a percentage. The formula used to calculate DGR is as follows (Wu *et al.* 2019):

$$LPH (\% \text{ per day}) = \frac{(\ln W_t - \ln W_0)}{t} \times 100$$

with:

W_t = average fish weight at the end of the study

W_0 = average weight of fish at the start of the study

t = research time

Feed Conversion Ratio

The feed conversion ratio (FCR) can be calculated using the following formula (Wang et al., 2022):

$$SR (\%) = \frac{N_t}{N_0} \times 100$$

with:

N_t = number of fish at the end of the study

N_0 = number of fish at the beginning of the study

Survival Rate

The survival rate (SR) can be calculated using the following formula (Wu et al. 2019):

$$FCR = \frac{I}{W_t - W_0}$$

with:

W_t = average weight of fish at the end of the study

W_0 = average weight of fish at the start of the study

I = amount of feed during the study

Statistical Analysis

The data obtained from the observation results were then analyzed using analysis of variance (ANOVA One-Way F Test) with a 95% confidence level. If the calculated F value differs significantly, the test is continued with the Duncan Test to determine the value between the differences.

RESULTS

The addition of kandis acid extract to commercial feed at various doses has a positive effect on the growth of tilapia fry. The highest increase in daily growth rate was observed with Treatment B (0.5%), which was 3.37% per day, followed by Treatments C (1%) and D (1.5%) which were relatively similar at 3.27% and 3.26% per day. Meanwhile, Treatment A showed the lowest daily growth rate (2.33% per day) (Table 1). The increase in growth performance that occurred with the addition of kandis acid extract was accompanied by a fairly large standard deviation value, especially in Treatments B and C, indicating a fairly large variation in individual growth.

Table 1. Growth Performance of Test Fish

Parameter	Treatment				η^2
	A (0%)	B (0,5%)	C (1%)	D (1,5%)	
LPH (% per day)	2,33 ^a ±0,28	3,37 ^a ±1,09	3,27 ^a ±1,21	3,26 ^a ±0,41	0,26
FCR	2,54 ^a ±2,33	1,30 ^a ±0,78	1,31 ^a ±0,23	4,29 ^a ±2,26	0,32
SR (%)	70,00 ^a ±10,00	60,00 ^a ±10,00	60,00 ^a ±17,32	53,33 ^a ±5,77	0,19

The best feed conversion ratio (FCR) was obtained in treatment B (1.30), followed by treatment C (1.31), indicating relatively efficient feed utilization. However, increasing the dosage of *Garcinia cowa* powder negatively affected FCR, as evidenced by treatment D exhibiting the highest FCR value (4.29). These results suggest that moderate inclusion of *Garcinia cowa* powder can enhance feed efficiency.

The highest *survival rate* (SR) was observed in treatment A (70%) and tended to decrease with increasing doses of *Garcinia cowa* powder, with treatment D showing the lowest SR of 53.33%. This indicates a negative impact of high doses of *Garcinia cowa* powder on the survival of the experimental fish.

DISCUSSION

Hydroxycitric Acid (HCA) is one of the bioactive compounds present in *Garcinia cowa* (Oktafirmanda *et al.*, 2022), which can help optimize the condition of the digestive tract by lowering pH, promoting the growth of lactic acid bacteria, and inhibiting the proliferation of pathogenic bacteria (Adila *et al.*, 2022). The inclusion of *Garcinia cowa* powder in commercial feed at a dosage of 0.5% (treatment B) provided the best performance, although statistically it was not significantly different from the control treatment. This is because HCA in *Garcinia cowa* can optimize the condition of the fish digestive tract, thereby enhancing the absorption of energy and nutrients from the feed. Efficient energy absorption positively affects the growth performance of fish and the effectiveness of feed utilization. Research conducted by Dada and Ikuerowo (2009) on the addition of *G. kola* extract to catfish feed demonstrated that supplementation with *G. kola* seed extract significantly increased the specific growth rate compared to the control. Furthermore, supplementation of mangosteen peel extract (*G. mangostana*) in Nile tilapia also significantly improved growth and feed efficiency (Yostawonkul *et al.*, 2023).

The best feed conversion ratios were obtained in treatments B (1.30) and C (1.31), indicating an increase in feed efficiency following the addition of *Garcinia cowa*. The HCA content in *Garcinia cowa* is believed to enhance feed efficiency by optimizing the condition of the fish digestive tract. This is consistent with Adila *et al.* (2022), who stated that hydroxycitric acid (HCA), a derivative of citric acid, can reduce pH in the digestive tract, thereby improving nutrient and feed absorption. Research by Soosean *et al.* (2010) also reported improved feed efficiency in catfish fry after administration of mangosteen bud extract (*G. mangostana*), although it was not significantly different from the control ($p < 0.05$).

The study data showed no significant differences among treatments across all tested parameters. A lack of statistical significance does not imply the absence of an effect; rather, the effect size may be too small to be detected statistically or the sample size may be too limited. Therefore, effect size (η^2) calculations are necessary to determine the potential influence of the treatment. The η^2 value for the daily growth rate (DGR) parameter was 0.26, categorized as a large potential effect on fish growth performance. For the FCR parameter, η^2 was 0.32 (large), indicating that the administration of *Garcinia cowa* powder has a potentially meaningful impact on feed efficiency. Additionally, for the survival rate (SR), η^2 was 0.19 (large), suggesting that the treatment contributes substantially to fish survival. These effect size calculations indicate that the inclusion of *Garcinia cowa* powder at a 0.5% dosage has the potential biological effect of enhancing daily growth rate and feed efficiency based on Cohen's categories, even though it did not reach statistical significance in the tests.

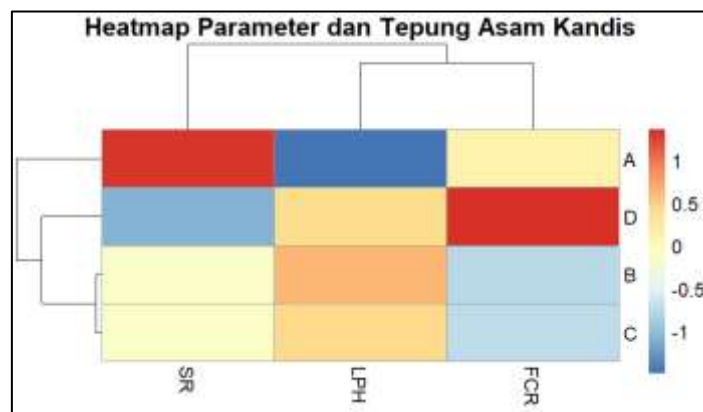


Figure 1. Heatmap graph of all parameters for treatment

The heatmap graph above (Figure 1) explains overall that the best treatment in this study was treatment B (0.5%), which was the most balanced with a tendency for LPH to increase and a decreasing FCR, while treatment D was the worst treatment due to a high FCR value and a decreasing SR. Treatment A had an advantage in survival rates but was weak in LPH and FCR parameters. Overall, the results of this study indicate the potential of kandis acid flour as a natural feed additive in fish feed, with a mechanism of optimizing digestive tract conditions by hydroxycitric acid, so that the process of feed nutrient absorption becomes more optimal and growth increases. However, the use of too high a dose can reduce fish growth performance.

CONCLUSION

The results of the study showed that the addition of 0.5% kandis acid flour (treatment B) to fish feed with the coating method, provided the best performance on the growth performance of tilapia seeds with a daily growth rate of 3.37% per day, a feed conversion ratio of 1.30, and a SR of 60%. All parameters tested in this study were not significantly different ($p < 0.05$), however, based on the effect size calculation, there was an indication that the provision of amino acid flour in feed had a potential biological effect on increasing daily growth rates and feed efficiency based on Cohen's categories, although it did not show a significant value based on the results of statistical tests.

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