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Kata kunci bersumber dari artikel. Lembar abstrak dapat dicuplik tanpa izin dan biaya

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Dietary chitosan and nano-chitosan of black soldier fly larvae for improving growth and physiological indices of *Clarias gariepinus*

*Pemberian kitosan dan nano-kitosan dari pupa lalat tentara hitam melalui pakan untuk meningkatkan pertumbuhan dan kinerja fisiologis *Clarias gariepinus**

Jurnal Riset Akuakultur, 20(2), 2025, 103-119

This research examined the effect of nutritional supplementation of 5% chitosan and nano-chitosan sourced from black soldier fly larvae exuviae on the growth and physiological profile of *Clarias gariepinus* (initial weight: 2.054 ± 0.02 g) over a period of 30 days. The feed treatments consisted of chitosan-supplemented, nano-chitosan-supplemented, and control feed, arranged in triplicate. In each trial unit, 30 fish were reared in plastic tanks (60 L capacity, filled with 50 L of freshwater). Growth, hematological profiles, and antioxidant activities were assessed after 30 days. The findings indicated that nano-chitosan markedly improved growth performance, as shown by increased final weight, body weight gain (BWG), and feed efficiency (FE), in comparison to chitosan and control diets. Specifically, nano-chitosan-fed fish exhibited a final weight of 2.878 ± 0.16 g ind⁻¹ and a feed conversion ratio (FCR) of 1.376 ± 0.15 , outperforming the chitosan group (2.660 ± 0.12 g ind⁻¹; 1.267 ± 0.12) and the control group (2.344 ± 0.04 g ind⁻¹; 1.857 ± 0.05). Additionally, nanochitosan significantly increased activities of antioxidant enzymes, including those of superoxide dismutase (SOD) and catalase (CAT), while reducing malondialdehyde (MDA) levels, indicating reduced oxidative stress. The hematological profile remained stable across the groups, confirming the safety of these feed additives. This research emphasizes nano-chitosan as a viable sustainable food additive for improving growth rate and oxidative resistance in *C. gariepinus*.

KEYWORDS: BSF; chitosan; *Clarias gariepinus*; growth; nano-chitosan; survival

Penelitian ini mengevaluasi pengaruh suplementasi diet dengan 5% kitosan dan nano-kitosan dari cangkang pupa lalat tentara hitam terhadap pertumbuhan serta indeks fisiologis *Clarias gariepinus* (berat awal: $2,054 \pm 0,02$ g) selama 30 hari. Perlakuan pakan terdiri atas pakan yang disuplementasi nano-kitosan, disuplementasi kitosan, dan kontrol yang diulang tiga kali. Pada masing-masing unit percobaan, 30 ekor ikan dipelihara di wadah plastik (kapasitas 60 L, diisi dengan air sebanyak 50 L). Setelah 30 hari pemeliharaan, pertumbuhan, profil hematologi, dan aktivitas antioksidan dievaluasi. Hasil penelitian menunjukkan bahwa nanokitosan meningkatkan kinerja pertumbuhan, yang ditunjukkan dengan peningkatan berat akhir, pertambahan bobot tubuh (PBT), dan efisiensi pakan (EP), dibanding dengan pakan kitosan dan kontrol. Secara khusus, ikan yang diberi pakan nano-kitosan menunjukkan bobot akhir $2,878 \pm 0,16$ g ekor⁻¹ dan rasio konversi pakan (RKP) $1,376 \pm 0,15$, lebih tinggi dari kelompok kitosan ($2,660 \pm 0,12$ g ekor⁻¹; $1,267 \pm 0,12$) dan kelompok kontrol ($2,344 \pm 0,04$ g ekor⁻¹; $1,857 \pm 0,05$). Selain itu, nano-kitosan secara signifikan meningkatkan aktivitas enzim antioksidan, termasuk superoksida dismutase (SOD) dan katalase (CAT), sekaligus menurunkan kadar malondialdehid (MDA), yang mengindikasikan berkurangnya stres oksidatif. Parameter hematologi tetap stabil di seluruh kelompok, yang menegaskan keamanan bahan tambahan pakan ini. Penelitian ini menyoroti nano-kitosan sebagai suplemen pakan berkelanjutan yang menjanjikan untuk meningkatkan laju pertumbuhan dan ketahanan oksidatif pada *C. gariepinus*.

KATA KUNCI: BSF; *Clarias gariepinus*; kelangsungan hidup; kitosan; nano-kitosan; pertumbuhan

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Manajemen budidaya udang vaname berkelanjutan berbasis pendekatan sosial, ekonomi, ekologi, institusi, dan teknologi: studi kasus di Ujung Genteng, Sukabumi

Sustainable whiteleg shrimp farming management based on social, economic, ecological, institutional, and technological dimensions: a case study in Ujung Genteng, Sukabumi

Jurnal Riset Akuakultur, 20(2), 2025, 121-145

Keberlanjutan pengelolaan akuakultur merupakan aspek krusial untuk memastikan produktivitas jangka panjang dan kesehatan lingkungan. Studi ini bertujuan untuk mengevaluasi status keberlanjutan budidaya udang vaname (*Penaeus vannamei*) di kawasan Ujung Genteng, Sukabumi, melalui pendekatan multidimensi yang mencakup dimensi sosial, ekonomi, ekologi, institusional, dan teknologi. Metode yang digunakan adalah *Rapid Appraisal for Fisheries* (RAPFISH) berbasis pendekatan *multi-dimensional scaling* (MDS) yang dimodifikasi untuk memasukkan dimensi teknologi serta validasi melalui ulangan Monte Carlo sebanyak 25 kali. Hasil menunjukkan dimensi teknologi memperoleh skor tertinggi (77,325), mengindikasikan “sangat berkelanjutan”, sementara dimensi lainnya, termasuk sosial (59,237), ekonomi (68,236), ekologi (61,856), dan institusional (60,215), dikategorikan sebagai “cukup berkelanjutan”. Dimensi sosial, ekonomi, ekologi, dan institusional memiliki atribut sensitif, berpotensi meningkatkan status keberlanjutan dari cukup berkelanjutan menjadi berkelanjutan hingga sangat berkelanjutan, yang meliputi semangat gotong royong dan hubungan dengan pemerintah (sosial), tujuan pemasaran dan penyerapan tenaga kerja (ekonomi), tingkat pemanfaatan lahan dan kualitas air tambak (ekologi) serta skala usaha dan kemitraan kelembagaan (institusional). Penekanan juga diberikan pada integrasi teknologi canggih seperti sistem *nanobubble*, pemberi pakan otomatis, energi surya, dan pemantauan *real-time* berbasis IoT. Inovasi-inovasi ini menunjukkan potensi signifikan dalam meningkatkan kadar oksigen terlarut, efisiensi pakan serta pengurangan biaya operasional, yang berkontribusi pada pertumbuhan udang yang lebih baik dan penurunan tingkat kematian. Temuan ini menegaskan pentingnya pendekatan holistik yang mengombinasikan kemajuan teknologi, keterlibatan komunitas, dan dukungan institusional untuk mencapai praktik akuakultur yang berkelanjutan. Rekomendasi untuk penelitian mendatang mencakup pengujian aplikasi yang lebih luas di berbagai lingkungan akuakultur serta pengembangan teknologi adaptif untuk menghadapi tantangan yang muncul di sektor budidaya udang.

KATA KUNCI: akuakultur; keberlanjutan; manajemen; RAPFISH; udang vaname

*Sustainability in aquaculture management is essential to ensure long-term productivity and environmental health. This study evaluates the sustainability status of whiteleg shrimp (*Penaeus vannamei*) farming in Ujung Genteng, Sukabumi, using a multidimensional approach covering social, economic, ecological, institutional, and technological dimensions. The Rapid Appraisal for Fisheries (RAPFISH) method, based on multi-dimensional scaling (MDS) and modified to include technology, was applied with 25 Monte Carlo iterations for validation. Results indicate that the technological dimension achieved the highest score (77.325), categorized as “highly sustainable”, while other dimensions, including social (59.237), economic (68.236), ecological (61.856), and institutional (60.215), were considered “moderately sustainable”. Sensitive attributes in social, economic, ecological, and institutional dimensions have the potential to improve sustainability status from moderately sustainable become sustainable to highly sustainable, including community cooperation and government relations (social), market orientation and employment absorption (economic), land use intensity and pond water quality (ecological), as well as business scale and institutional partnerships (institutional). The study highlights the role of advanced technologies such as nanobubble systems, automatic feeders, solar energy, and IoT-based real-time monitoring. These innovations can enhance dissolved oxygen levels, improve feed efficiency, reduce operational costs, and ultimately support better shrimp growth and lower mortality rates. Overall, the findings emphasize the importance of a holistic approach combining technological innovation, community involvement, and institutional support to achieve sustainable aquaculture. Future research is recommended to expand applications across diverse aquaculture environments and to develop adaptive technologies for emerging challenges in shrimp farming.*

KEYWORDS: aquaculture; management; RAPFISH; sustainability; whiteleg shrimp

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Aktivitas antibakteri dari senyawa fitokimia ekstrak daun *Avicennia marina* dan *Avicennia alba* terhadap isolat bakteri *Vibrio* sp. dari tambak udang intensif

Antibacterial activity of phytochemical compounds of Avicennia marina and Avicennia alba leaves extracts against Vibrio sp. isolates from intensive shrimp ponds

Jurnal Riset Akuakultur, 20(2), 2025, 147-164

Bakteri *Vibrio* sp. merupakan kelompok bakteri patogen yang dapat menyebabkan penyakit vibriosis, sehingga memicu tingginya potensi kematian dan kegagalan panen budidaya udang intensif. Salah satu upaya untuk mengendalikan prevalensi penyakit ini adalah dengan mengoptimalkan pemanfaatan senyawa metabolit sekunder dari daun mangrove. Penelitian ini bertujuan untuk mengetahui kandungan fitokimia dan aktivitas antibakteri ekstrak daun *Avicennia marina* dan *Avicennia alba* terhadap bakteri *Vibrio* sp. dari tambak udang intensif di sekitar Selat Madura. Ekstraksi daun mangrove dilakukan menggunakan metode maserasi. Aktivitas antibakteri diuji dengan metode difusi cakram pada konsentrasi 10.000 ppm, 40.000 ppm, dan 80.000 ppm. Penelitian ini dirancang dengan model rancangan acak lengkap (RAL) faktorial. Hasil penelitian menunjukkan bahwa kedua ekstrak mangrove mengandung senyawa saponin, tanin, dan triterpenoid. Zona hambat bakteri pada ekstrak *A. marina* berkisar $1,43 \pm 0,72$ - $4,31 \pm 1,80$ mm, sedangkan zona hambat pada *A. alba* berkisar $1,43 \pm 0,72$ - $4,71 \pm 0,01$ mm. Zona hambat yang terbentuk juga menunjukkan bahwa aktivitas antibakteri kedua ekstrak daun mangrove pada konsentrasi 10.000 ppm dan 40.000 ppm tergolong lemah, sedangkan 80.000 ppm tergolong sedang. Pemberian konsentrasi ekstrak yang berbeda berpengaruh nyata terhadap zona hambat bakteri yang dihasilkan, namun jenis ekstrak secara signifikan tidak terdapat interaksi nyata terhadap konsentrasi ekstrak mangrove yang digunakan. Secara keseluruhan hasil penelitian menunjukkan bahwa ekstrak daun *A. marina* dan *A. alba* dari Selat Madura berpotensi sebagai agen antibakteri alami terhadap bakteri *Vibrio* sp. pada budidaya udang intensif.

KATA KUNCI: mangrove; senyawa metabolit sekunder; vibriosis; zona hambat bakteri

Vibrio sp. bacteria are a group of pathogenic bacteria that can cause vibriosis, leading to high mortality rates and crop failure in intensive shrimp farming. One of the efforts to control the prevalence of this disease is by optimizing the use of secondary metabolites from mangrove leaves. This study aimed to determine the phytochemical content and antibacterial activity of *Avicennia marina* and *Avicennia alba* leaves extracts against *Vibrio* sp. bacteria from intensive shrimp ponds around the Madura Strait. Mangrove leaves extraction was carried out using the maceration method. Antibacterial activity was tested using the disc diffusion method at concentrations of 10,000 ppm, 40,000 ppm, and 80,000 ppm. The study was designed using a factorial completely randomized design (CRD). The results showed that both mangrove extracts contained saponins, tannins, and triterpenoids. The inhibition zone of bacteria in *A. marina* extract ranged from 1.43 ± 0.72 to 4.31 ± 1.80 mm, while in *A. alba* extract, it ranged from 1.43 ± 0.72 to 4.71 ± 0.01 mm. The inhibition zones also indicated that the antibacterial activity of both mangrove leaves extracts at concentrations of 10,000 ppm and 40,000 ppm was categorized as weak, while at 80,000 ppm it was categorized as moderate. Different extract concentrations had a significant effect on the bacterial inhibition zones produced; however, the type of extract showed no significant interaction with the concentrations of mangrove extract used. Overall, the results indicate that *A. marina* and *A. alba* leaves extracts from the Madura Strait have potential as natural antibacterial agents against *Vibrio* sp. in intensive shrimp farming.

KEYWORDS: bacterial inhibition zone; mangrove; secondary metabolite compounds; vibriosis

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Effects of spinach (*Amaranthus* sp.) extract supplementation on molting duration and physiological responses of mud crabs (*Scylla* sp.) reared in crab apartment systems

Pengaruh suplementasi ekstrak bayam (Amaranthus sp.) terhadap durasi molting dan respons fisiologis kepiting bakau (Scylla sp.) yang dipelihara dalam sistem apartemen kepiting

Jurnal Riset Akuakultur, 20(2), 2025, 165-180

This study investigates the effects of dietary supplementation of spinach (*Amaranthus* sp.) extract, rich in phytoecdysteroids, on the molting process and physiological parameters of mud crabs (*Scylla* sp.) cultivated in crab apartment boxes integrated with a recirculating aquaculture system. This experiment was designed using a completely randomized design (CRD) with four different doses of spinach extract as treatments (0, 300, 700, and 1000 ng g⁻¹ of crab) and three replications. Some parameters measured were molting duration, hormone levels, including ecdysteroid and molt inhibiting hormone (MIH), reactive oxygen species (ROS), and water quality. The results showed that higher doses of spinach extract significantly shortened the molting duration ($p < 0.05$), with the fastest molting observed at 1000 ng g⁻¹ (11.83 ± 1.26 days). Increased spinach extract doses also significantly affected MIH and ROS levels. Specifically, MIH levels increased from 12.05 ng mL⁻¹ in the control to 20.88 ng mL⁻¹ in treatment D, while ROS levels rose from 116.80 to 147.33 μmol mL⁻¹. Overall, the administration of phytoecdysteroids from spinach presents a promising, eco-friendly approach to enhance soft-shell crab production efficiency, although careful dose optimization is necessary to balance production acceleration with animal welfare.

KEYWORDS: molting; phytoecdysteroids; *Scylla* sp.; soft-shell crab; spinach extract

Penelitian ini mengkaji pengaruh suplementasi pakan dengan ekstrak bayam (Amaranthus sp.) yang kaya akan fitoekdistteroid terhadap proses molting dan parameter fisiologis kepiting bakau (Scylla sp.) yang dibudidayakan dalam kotak apartemen kepiting terintegrasi dengan sistem akuakultur resirkulasi. Percobaan ini dirancang menggunakan rancangan acak lengkap (RAL) dengan empat dosis ekstrak bayam sebagai perlakuan (0, 300, 700, dan 1000 ng g⁻¹ kepiting) dan tiga ulangan. Beberapa parameter yang diukur meliputi durasi molting, kadar hormon termasuk ekdisteroid dan molt inhibiting hormone (MIH), reactive oxygen species (ROS), serta kualitas air. Hasil penelitian menunjukkan bahwa peningkatan dosis ekstrak bayam secara signifikan memperpendek durasi molting ($p < 0,05$), dengan waktu molting tercepat pada dosis 1,000 ng g⁻¹ (11,83 ± 1,26 hari). Peningkatan dosis ekstrak bayam juga berpengaruh nyata terhadap kadar MIH dan ROS. Secara khusus, kadar MIH meningkat dari 12,05 ng mL⁻¹ pada kontrol menjadi 20,88 ng mL⁻¹ pada perlakuan D, sedangkan kadar ROS naik dari 116,80 menjadi 147,33 μmol mL⁻¹. Secara keseluruhan, pemberian fitoekdistteroid dari bayam menunjukkan potensi sebagai pendekatan ramah lingkungan untuk meningkatkan efisiensi produksi kepiting cangkang lunak, meskipun demikian optimasi dosis tetap diperlukan agar tercapai keseimbangan antara percepatan produksi dan kesejahteraan hewan.

KATA KUNCI: ekstrak bayam; fitoekdistteroid; kepiting soka; molting; *Scylla* sp.

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Evaluasi penggunaan limbah pendederan ikan kerapu bebek (*Cromileptes altivelis*) dengan konsentrasi berbeda sebagai media kultur *Spirulina* sp. skala menengah

*Evaluating different concentrations of humpback grouper (*Cromileptes altivelis*) nursery effluent as a culture medium for intermediate-scale cultivation of *Spirulina* sp.*

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Limbah pendederan ikan kerapu bebek (*Cromileptes altivelis*), kaya akan nitrogen (N) dan fosfor (P), berpotensi mencemari lingkungan apabila dibuang tanpa pengolahan. Penelitian ini bertujuan menentukan konsentrasi optimal limbah pendederan tersebut sebagai media kultur *Spirulina* sp. skala menengah. Limbah disaring (filter 25 μm) dan disterilkan menggunakan autoklaf (121°C, 15 menit, 1 atm) pada konsentrasi 10%, 15%, 20% dan 25%. Kultur dilakukan selama 9 hari dalam wadah fiberglass volume 15 L, diinokulasi dengan kepadatan awal 1×10^6 sel mL^{-1} , diaerasi secara terus-menerus, dan diberikan pencahayaan. Rancangan percobaan yang digunakan adalah rancangan acak lengkap (RAL) dengan tiga ulangan untuk mengevaluasi laju pertumbuhan *Spirulina* sp., penurunan konsentrasi nitrat dan fosfat, serta parameter kualitas air (suhu, salinitas, pH, dan intensitas cahaya). Hasil menunjukkan bahwa perlakuan limbah 20% menghasilkan kepadatan tertinggi ($6,43 \times 10^6$ sel mL^{-1}) dan efisiensi penurunan konsentrasi nitrat sebesar 96,0% (dari $5,99 \pm 0,13$ mg L^{-1} menjadi $0,24 \pm 0,05$ mg L^{-1}) dan penurunan fosfat sebesar 67,7% (dari $6,66 \pm 0,34$ mg L^{-1} menjadi $2,15 \pm 0,32$ mg L^{-1}). Penelitian ini menunjukkan bahwa limbah pendederan *C. altivelis* yang disterilisasi efektif digunakan sebagai media kultur *Spirulina* sp. skala menengah, dengan konsentrasi 20% memberikan hasil pertumbuhan, efisiensi penyerapan nutrisi, dan kestabilan kualitas air terbaik, sehingga berpotensi diterapkan sebagai strategi bioremediasi berkelanjutan dalam konsep akuakultur sirkular.

KATA KUNCI: akuakultur berkelanjutan; bioremediasi; fosfat; limbah budidaya; nitrat; *Spirulina* sp.

*Effluent from humpback grouper (*Cromileptes altivelis*) nursery operations is rich in nitrogen (N) and phosphorus (P), posing a risk of environmental pollution if discharged untreated. This study aimed to determine the optimal concentration of humpback grouper nursery effluent as a rearing medium for *Spirulina* sp. cultured at an intermediate scale. The effluent was filtered (25 μm) and sterilized using an autoclave (121°C, 15 minutes, 1 atm) at concentrations of 10%, 15%, 20%, and 25%. *Spirulina* sp. was cultured at an initial density of 1×10^6 cells mL^{-1} in 15-L fiberglass tanks that were continuously aerated and illuminated for 9 days. A completely randomized design (CRD) with three replications was used to evaluate the growth rate of *Spirulina* sp., the reduction of nitrate and phosphate concentrations, and water quality parameters (temperature, salinity, pH, and light intensity). Results showed that the 20% wastewater produced the highest cell density (6.43×10^6 cells mL^{-1}) and achieved a nitrate concentration reduction efficiency of 96.0% (from 5.99 ± 0.13 mg L^{-1} to 0.24 ± 0.05 mg L^{-1}) and a phosphate reduction of 67.7% (from 6.66 ± 0.34 mg L^{-1} to 2.15 ± 0.32 mg L^{-1}). This study demonstrated that sterilized effluent from humpback grouper nursery can be used as the rearing medium for *Spirulina* sp. cultured at an intermediate scale, with a 20% concentration providing optimal growth, nutrient removal efficiency, and stable water quality, thereby supporting its potential use as a sustainable bioremediation and circular aquaculture strategy.*

KEYWORDS: aquaculture wastewater; bioremediation; nitrate; phosphate; *Spirulina* sp.; sustainable aquaculture

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Potensi biji dan daun jarak pagar (*Jatropha curcas*) sebagai sumber protein alternatif dan imunostimulan dalam mendukung akuakultur berkelanjutan: kajian pustaka

*Potential of castor oil plant (*Jatropha curcas*) as an alternative source of protein and immunostimulant in supporting sustainable aquaculture: a review*

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Krisis pangan global dan tingginya kebutuhan protein hewani menuntut adanya sumber protein alternatif yang berkelanjutan dalam akuakultur. Ketergantungan pada tepung ikan sebagai bahan pakan utama menghadapi kendala berupa keterbatasan pasokan dan fluktuasi harga, sehingga diperlukan eksplorasi bahan nabati dengan potensi tinggi, antara lain jarak pagar (*Jatropha curcas*). Artikel ini bertujuan untuk mengkaji potensi jarak pagar sebagai sumber protein alternatif dalam pakan akuakultur. Metode penelitian yang digunakan dalam kajian ini adalah metode kualitatif dengan teknik pengumpulan data melalui studi literatur atau kajian pustaka. Data diperoleh dengan mempelajari teori, konsep, dan hasil penelitian terdahulu yang relevan dengan topik. Sumber kajian berasal artikel jurnal bereputasi nasional, internasional dan prosiding yang diterbitkan dari tahun 2010-2025. Proses pengumpulan literatur dilakukan melalui berbagai basis data seperti Scopus, Web of Science, PubMed, MDPI, Springer Link dan Google Scholar dengan menggunakan kata kunci yang sesuai. Hasil kajian menunjukkan bahwa jarak pagar mengandung protein tinggi 56–64% dengan profil asam amino lengkap serta senyawa bioaktif (flavonoid 0,09–2,92%, saponin 0,092–3,5%, tanin 0,0049–0,395%, fenolik 0,48-38%, alkaloid 0,070-0,50% terpenoid 0,022%) yang berfungsi sebagai imunostimulan. Proses detoksifikasi mampu menurunkan kandungan antinutrisi hingga 85%. Aplikasinya dalam pakan mampu menggantikan tepung ikan dan kedelai sebesar 10–40%, meningkatkan pertumbuhan, efisiensi pakan, respons imun, dan kelangsungan hidup organisme budidaya hingga 88,3%. Kajian ini menyimpulkan jarak pagar memiliki potensi sebagai sumber protein alternatif dalam pakan akuakultur karena kandungan nutrisinya yang tinggi dan keberadaan senyawa bioaktif yang bermanfaat melalui metode pengolahan yang tepat. Namun, pemanfaatannya masih terbatas oleh kandungan senyawa toksik yang memerlukan proses detoksifikasi efektif dan aman. Tantangan riset ke depan mencakup optimalisasi teknologi detoksifikasi dan analisis kelayakan aplikasinya dalam skala industri.

KATA KUNCI: akuakultur; detoksifikasi; jarak pagar; limbah; pakan

*The global food crisis and the increasing demand for animal protein necessitate sustainable alternative protein sources in aquaculture. Dependence on fishmeal as the primary feed ingredient faces challenges due to limited supply and fluctuating prices, making it essential to explore high-potential plant-based materials such as *Jatropha curcas*. This article aims to review the potential of *Jatropha curcas* as a protein source alternative in aquaculture feed. The research employed a qualitative method through a literature review, analyzing theories, concepts, and previous studies relevant to the topic. The data sources were peer-reviewed national and international articles and conference proceedings published between 2010 and 2025. Literature was collected from various databases, including Scopus, Web of Science, PubMed, MDPI, Springer Link, and Google Scholar, using predetermined keywords. The findings indicate that *Jatropha curcas* contains high protein (56–64%) with a complete amino acid profile and bioactive compounds (flavonoids 0.09–2.92%, saponins 0.092–3.5%, tannins 0.0049–0.395%, phenolics 0.48–38%, alkaloids 0.070–0.50%, terpenoids 0.022%) that function as immunostimulants. Detoxification processes can reduce antinutritional factors by up to 85%. Its application in aquafeed can substitute 10–40% of fishmeal and soybean meal, improving growth, feed efficiency, immune response, and survival rate of cultured organisms up to 88.3%. This review concludes that *Jatropha curcas* has strong potential as an alternative protein source in aquaculture feed due to its high nutritional content and beneficial bioactive compounds when processed appropriately. However, its utilization remains constrained by toxic compounds that require effective and safe detoxification. Future research challenges include optimizing detoxification technologies and evaluating the plant feasibility for industrial-scale applications.*

KEYWORDS: aquaculture; detoxification; *Jatropha curcas*; waste; feed

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AUTHOR GUIDELINES OF JURNAL RISET AKUAKULTUR FOR WRITING FORMAT AND PUBLICATION PROCESS

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ABSTRACT

Abstract is written in bahasa and English using 12-point Times New Roman single space with justified alignment. English abstract is followed by the English version of the title which is typed using bold capitalized each word letters. Abstract must not exceed than 250 words and contains the brief outline of the problem statement and aims of the study, brief methodology, the main findings or results, and conclusion.

KEYWORDS: author guidelines; Jurnal Riset Akuakultur; publication process; writing format

ABSTRAK: *Panduan Format Penulisan Jurnal Riset Akuakultur (Terjemahan dari Judul Artikel yang ditulis dalam Bahasa Indonesia Maksimal 20 Kata)*

Abstrak ditulis dalam bahasa Indonesia dan Inggris menggunakan font Times New Roman 12 spasi satu dengan rata kiri dan kanan. Abstrak bahasa Inggris diikuti dengan judul naskah versi bahasa Inggris yang diketik tebal dengan huruf pertama kapital pada setiap kata. Abstrak tidak boleh lebih dari 250 kata dan berisi ringkasan masalah dan tujuan penelitian, metodologi singkat, temuan utama atau hasil penelitian, dan kesimpulan.

KATA KUNCI: *format penulisan; Jurnal Riset Akuakultur; petunjuk penulisan; proses publikasi*

INTRODUCTION

Introduction must be concise and at least has several components including an adequate background related to the research, problem statement, some literature review from previous studies, the research gap, and the aims of the study. Introduction is written using double space line, single column, 12-point Times New Roman with justified alignment. Text citation of references uses author-date style according to APA 7th Edition and multiple references are listed in alphabetical order separated by semicolon among references to differentiate citations, e.g. (Smith & Jones, 2016; Williams, 2014). Use “and” when giving a citation in sentences and “&” for parentheses, e.g. Smith and Jones (2016) or (Smith & Jones, 2016).

MATERIALS AND METHODS

This section presents a clear and concise research procedures for others to be able to replicate the study. The use of subsections is allowed to explain some different continued-procedures. This section also provides ethical clearance statement for the research which applies an experiment on animals or human. The materials and equipment used must be mentioned with their specifications consisting of the trademark, supplier or manufacture name, and region or country. This section also covers a brief narration about data analysis. Methods that have been published should be summarized and completed with in-text-citation. Modified methods should be clearly described its modification from the previous cited methods. Use the international system of units (SI) or SI-derived units to express unit of measurements. Minus index is suggested being used rather than using slash (/), e.g.: mg L⁻¹, g L⁻¹, not mg/L or g/L. This section is typed in 12-point Times New Roman, double space line, a single column with justified alignment.

RESULTS AND DISCUSSION

Results and discussion must be combined in one section. The statement of the results can be summarized from the data appeared in the figures and tables. Discussion should explore the significance of the results or comparison to previous studies and represent the causal factors why and how the results were taken place, do not re-express the mentioned data in figures and tables in the form of sentences within results. Figures and tables can be placed in this section completed with cross-reference of the figures or tables stated in the text. This section is written in 12-point Times New Roman, double space line, a single column format with justified alignment.

Tables and figures must be placed within the main text, those can be placed in sections of materials and methods or results and discussion (if applicable). The preparation of tables can follow the guidance below:

1. Provide an editable form of tables, do not place any tables in the form of images.
2. The titles of tables should be consecutively numbered using Arabic numerals, please cite the tables in the text or give cross-reference of tables in the text.
3. The titles of tables are written in both in bahasa and English for the manuscript written

in bahasa, or only in English for the manuscript in English. Type the title using 12-point Times New Roman, single space with sentence case letters in justified alignment, and give hanging indent for the second and consecutive lines of the table title.

4. The body of the table is typed in 10-point Times New Roman, single space with left alignment, only column headings are typed in bold.
5. Please provide bahasa and English versions of any text in the body of the table for the manuscript submitted in bahasa, use italic font to type the English version of the text, while all the text in the table body of the manuscript submitted in English is only provided in English.
6. Use single horizontal lines to separate column heading and to indicate the end of the table, other horizontal lines are not needed. Vertical lines should not be used in the tables.
7. Capitalize only the first letter of the first word in each column and row entry.
8. All abbreviations and symbols or any statistical explanation and used literatures in the table body must be described in footnotes placed below the table and written in 10-point Times New Roman, single space in justified alignment.

An example of table format can be seen below.

Table 1. Average of survival rate, absolute weight growth, absolute length growth, and daily growth rate Asian redtail catfish fry fed different percentages of fermented sago dregs and anchovy head meal feed.

<i>Treatments</i>	<i>SR (%)</i>	<i>AWG (g)</i>	<i>ALG (cm)</i>	<i>DGR (% day⁻¹)</i>
P1	56,67 ± 22,5	0,12 ± 0,01 ^b	1,47 ± 0,39	0,57 ± 0,06 ^b
P2	58,33 ± 10,4	0,11 ± 0,01 ^b	1,42 ± 0,54	0,56 ± 0,03 ^b
P3	75,00 ± 10,0	0,16 ± 0,01 ^c	1,54 ± 0,17	0,78 ± 0,06 ^c
P4	66,67 ± 25,6	0,07 ± 0,00 ^a	1,20 ± 0,07	0,32 ± 0,01 ^a

Note: Values with different superscript letters in the same column indicate significantly different results ($P < 0,05$). P1 = Feeding with percentages of 6%, P2 = 8%, P3 = 10 %, P4 = 12% from body weight of fish fry. SR = survival rate; AWG = absolute weight growth; ALG = absolute length growth; DGR = daily growth rate.

The preparation of figures should refer the guidance below:

1. Figures should be provided in either vector art formats (Illustrator, EPS, WMF, FreeHand, CorelDraw, PowerPoint, Excel, etc.) or bitmap formats (Photoshop, TIFF, GIF, JPEG, etc.). Bitmap images should be of 300 dpi resolution. Provide an editable form of charts, not as images.

2. The titles of figures should be consecutively numbered using Arabic numerals, please cite the figures in the text or give cross-reference of figures in the text.
3. The titles of figures are written in both in bahasa and English for the manuscript written in bahasa, or only in English for the manuscript in English. Type the title using 12-point Times New Roman, single space with sentence case letters in justified alignment, and give hanging indent for the second and consecutive lines of the table title. Place the figure title below the figure.
4. Please provide bahasa and English versions of any text in the body of the figure for the manuscript submitted in bahasa, use italic font to type the English version of the text, while all the text in the figure body of the manuscript submitted in English is only provided in English.
5. Capitalize only the first letter of the first word in any text contained in the figure body.
6. All abbreviations and symbols or any statistical explanation and used literatures in the figure body must be described in footnotes placed below the figure title and written in 10-point Times New Roman, single space in justified alignment.

An example of figure format is presented below.

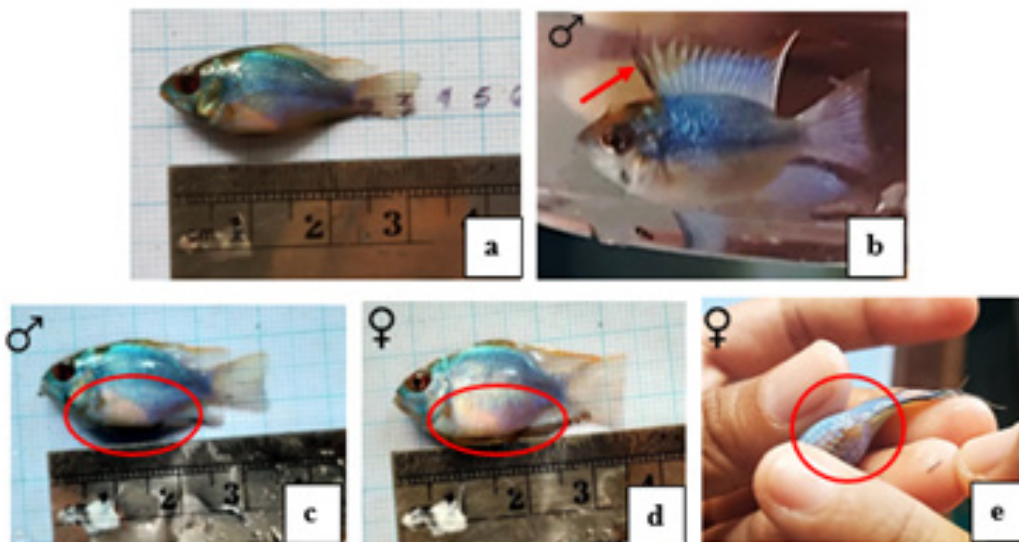


Figure 1. Visual observations of gonad matured ramirezi broodstock: (a) research start (b) ramirezi male at the end of the research with a black elongated front dorsal fin (c) ramirezi male with a bluer body and belly (d) ramirezi female with a pink belly (e) prominent and yellow urogenital.

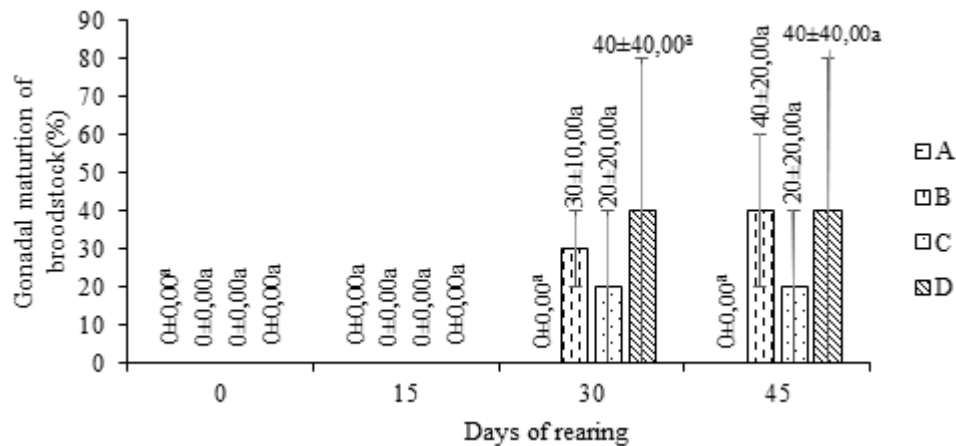


Figure 2. Accumulation percentage of gonadal mature ramirezi broodstock after treatments (combined ratio of artificial feed to bloodworms (*Chironomus* sp.): (A) 3:0, (B) 0:3, (C) 2:1, and (D) 1:2)) on day 0 to day 45

Note: The results presented are based on data normalization. Different superscripts in the same days of rearing indicate significant differences at a confidence level of 95% ($P < 0.05$).

CONCLUSION

Conclusions must summarize the results and answers the research questions or aims. Conclusions should be combined with the summary of the discussions which explains why or how the highlighted results obtained. This section is written in 12-point Times New Roman, double space line, a single column format with justified alignment.

ACKNOWLEDGMENTS

This section is used to acknowledge any institutions or individuals that provide funding sources or help during the study. The research which was funded by a research grant must mention the name of research grant and its detail such the funding organization and associated grant number (if applicable). This section is written in 12-point Times New Roman, double space line, a single column format with justified alignment.

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