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Research Article

MADRE DE AGUA (TRICHANTHERA GIGANTEA) LEAVES AND RICE (*ORYZA SATIVA* L.) BRAN AS ORGANIC FEEDS FOR DUCK (ANAS PLATYRHYNCHOS)

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Abstract

The study aimed to formulate an organic duck feed using a mixture of Madre de Agua leaves and rice bran. The study focused on the phytonutrient compositions of the leaves, the steps in the formulation of organic feed for duck, the growth yield by weight of the duck using emerge feed formulations, the significant difference in growth yield by weight using the three formulations, and the contributions to poultry development from the newly formulated organic duck feed.The findings revealed that Madre de Agua leaves contained 18.07% ash, 15.80% crude protein, 1.15% crude fat, 15.42% crude fiber, 4.70% calcium, and 0.32% total phosphorus. Rice bran contained fiber, protein, ash, calcium, iron, moisture, oil, potassium, and saturated fat. The steps involved growing, collecting, drying, and chopping the leaves of Madre de Agua finely and purchasing Rice bran. The mixture was then shaped into pellets and dried to create the final product.The study concluded that Madre de Agua leaves and rice bran are highly beneficial for poultry farming, contributing significantly to the well-being and vitality of poultry. The study also showed that there were easy and simple steps in the preparation of organic feed for duck, and the growth yield of duck fed with formulation 1 with a higher portion of Madre de Agua leaves was the most significant.

Keywords: Madre de Agua, Rice Bran, Organic Feeds.

INTRODUCTION

The global demand for poultry products continues to rise, driven by population growth and increasing consumer preferences for animal protein. Poultry is one of the most significant and widespread form of livestock production worldwide due to its efficiency in converting feed into protein and the versatility of its products. As a result, poultry producers face the challenge of providing a consistent and cost-effective supply of nutritious feed for their livestock. Conventional feed ingredients, such as soybean meal and corn, have been the primary sources of poultry nutrition; however, concerns regarding sustainability, environmental impact, and rising feed costs have sparked interest in exploring alternative and locally available feed ingredients. The Philippines poultry industry is thriving due to its sustainable and environmentally friendly practices. The industry provides affordable protein, livelihood opportunities, and supports food security goals. To meet the growing demand, the industry is adapting with improved technologies and sustainable approaches. Sustainability is important in the Philippines. Moreover, sustainability in agriculture can lead to lower commodity prices. According to the law of supply and demand, when the supply of a commodity increases, its price tends to decrease. By adopting sustainable practices, farmers can increase their yield, thereby increasing the supply of 2 agricultural products in the market. This increased supply can lead to lower prices, making food more affordable for the average Filipino. As indicated in Sustainable Development Goals 2030, particularly Goal no. 2, which states that sustainability of food production is important in the country. It does not only provide adequate supply of the food needed for human consumption, but it is also a strategy to have lower prices of commodities as explained by the law of supply and demand.

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Considering this, Republic Act 10068, as amended by Republic Act 11511, also known as Organic Agriculture Act of 2010 states that:

"The law aims to promote, propagate, further develop, and implement the practice of organic agriculture in the Philippines. It will help cumulatively condition and enrich the fertility of the soil, increase farm productivity and farmers' income, in line with this it reduces pollution and destruction of the environment, to prevent the depletion of natural resources and encourage the participation of indigenous organic farmers in promoting their sustainable practices, further protect the health of farmers and the general public save on imported farm inputs, and promote food self-sufficiency."

Along with this, at Municipality of Calabanga, province of Camarines Sur Philippines has a significant poultry industry, contributing to the local economy and producing duck meat and eggs. Duck meat is a rich source of essential vitamins and minerals, including iron, B vitamins, and omega-3 fatty acids, making it an excellent addition to a healthy diet. These nutrients support functions like immune response, cellular repair, nerve signals, and blood oxygenation. Iron is an essential mineral in the body that supports red blood cells, and duck meat provides 2.4mg of iron per 100g of duck meat. Duck meat also contains B vitamins, which are crucial for carb metabolization, and omega-3and omega-6 fatty acids. In connection with this, Madre de Agua is a highly effective protein source for feeds for various animals, including chickens, duck, pigs, goats, cows, and fish. It contains 88.44% dry matter, 18.21% crude protein, 12.5% crude fiber, 2.66% crude fat, 21.80% ash, 11.56% moisture, 5% calcium, and 18.07% ash. The leaves used in Madre de Agua farming maintain a balance between animal nutritional needs and environmental sustainability, increasing productivity, improving animal welfare, reducing costs, and promoting

biodiversity in natural ecosystems. This sustainable method is ideal for small-scale animal raising, promoting biodiversity, and reducing costs. With many raw and organic materials available, many possible feeds for ducks can be formulated. Using organic feeds for these ducks may not only have an effect on the cost of production, it may also reduce side effects in foods produced using inorganic elements. Thus, health of the consumers is also considered. The growing interest in sustainable and organic poultry farming practices is driven by consumer demands for healthier, more environmentally friendly products. One promising option is the combination of Madre De Agua and Rice Bran, a tropical plant species known for its nutritional potential. This study aims to assess the feasibility of using Madre De Agua and Rice Bran as organic feeds for ducks, focusing on their impact on growth performance and nutritional considerations. Key parameters such as body weight gain feed conversion efficiency will be evaluated to determine the practicality of this feed combination.

Madre de Agua (Trichanthera gigantea)

This review aims to synthesize existing research on Trichanthera gigantea, highlighting its potential as an alternative feed source, its impact on livestock growth and productivity, and its broader ecological benefits. By examining these studies, the practical applications and advantages of integrating Madre de Agua into agricultural systems can be understood better. “Madre de Agua” or “Nacedero” is the common name for Trichanthera gigantea, a multipurpose, versatile tree native to South America. It thrives in a wide range of tropical ecosystems and is used for fodder for pigs, rabbits, and ruminants. In Latin America, it is used to protect water courses, hence its name “Madre de Agua” (Feedipedia 2024). It has also been introduced to other tropical regions, such as the Philippines. Phytonutrients are natural compounds produced by plants. They help protect plants from threats such as insects, diseases. These compounds are found in a variety of plant-based foods, including fruits, vegetables, whole grains, nuts, beans, and tea.

Moreover, Madre de Agua is a beautiful and useful plant that is found in many tropical regions. It is a valuable resource for both humans and animals. The importance of having this information in the present study is to provide ideas on how to grow Madre de Agua where they are least found. In this way, there is an assurance to have continuous supply of the raw material as ingredient to feed ducks. The study of Lacayanga, (2015) discussed that Madre de Agua leaves are rich source of protein, vitamins, and minerals, making them an excellent addition to poultry diets. The leaves of Madre de Agua contain 18-22% crude protein in dry matter form. This makes it a potential source of protein for animals. Crude protein content ranges from 18% to 22%, providing essential amino acids for muscle growth and development (De la Cruz, 2015).

In another study made by De la Cruz (2017) the amino acid profile of Madre de Agua leaves like that of soybean meal, a common protein source in animal feed this suggests that Madre de Agua leaves could be a good substitute for soybean meal in animal diets. Additionally, in the study of Lacayanga (2015) Madre de Agua is a good source of minerals, including calcium, phosphorus, and potassium, that been shown to have antioxidant activity this suggests that it could be used as a natural antioxidant in animal feed this makes it a nutritious feed ingredient for animals. The leaves are also a good source of vitamins A, C, and E, which play crucial roles in maintaining immune function and overall poultry health. Lastly, Madre de Agua is rich in minerals such as calcium, phosphorus, and potassium, essential for bone health, egg production, and overall metabolic processes. This information would make a positive acceptance of including Madre de Agua as ingredient to feed duck. Moreover, consumers will not have a negative behavior towards the consumption of farmed duck where feeds from vegetative sources are used.

In the study made by Kamboh *et al.* (2015) the use of leaf meal has been reported to reduce the cost commercial feeds and improve the health status and physiological conditions of poultry species in farms. Still, In the study made by Buragohin (2016) there is a potential as an alternative to commercial feeds alleviates the growth performance of ducks. Studies have demonstrated that incorporating Madre de Agua into poultry diets can positively impact growth performance and egg production. Similarly, in the study of Duarte *et al.* (2014) supplementation with Madre de Agua leaves has been shown to increase average daily gain, feed conversion ratio, and carcass weight in ducks. In laying hens, Madre de Agua supplementation has been associated with increased egg production, improved egg yolk color, and enhanced eggshell quality (Ramírez *et al.,* 2014). Adding 15% of Madre de Agua leaf as feed supplement, have delayed point of lay egg as a result of high significant effects on egg length, shape index, shell thickness and cholesterol contents (Bejar, 2017).

Whereas, the study of (Libatique, 2020) the different level of Madre de Agua for growth performance of pekin ducks with the experimental diets as follows: T1,T2,T3, and T4 containing of 0%,5%,10%, and 15% respectively of Madre de Agua leaf meal. The supplementation of 15% was desirable for production, because the wight and feed conversion ratio efficiency gained considerable. Similar to the study of Bejar (2017) that 15% of Madre de Agua leaf as feed supplement to duck have delayed point of lay as result of highly significant effect on egg length, shape index, shell thickness, yolk color, and cholesterol content. Additionally, Olorontola *et al.* (2016) mentioned nowadays due to increase in feeds prices, particularly for protein-rich feed ingredients the incorporation of leaf meal into duck diet is encourage improve growth rate.

In the study of Sugihartoel *et al.* (2019) Leaf meal contain of protein and contains a wide variety of biological active components that may serve as growth promoting and health improving agents. Feeding leaf meal also noticed to improve the product qualities of duck it results in increasing feed intake, feed conversion rate, daily weight growth, and total body weight in livestock animals. Active ingredients in leaf meal are most likely to involved in improving the immune competence, intestinal microbial and gut health of ducks (Huang *et al.,* 2018). The antibacterial properties effects of the bioactive the leaf meal seen to attributable to the therapeutic effects of the leaf (Sharna *et al.,* 2016). Moreover, the study of Morbos *et al.* (2016) revealed that the average daily gains have a significant effect, hence the study of Ligantique (2017) the different level of Madre de Agua for growth performance of ducks the supplantation of 15% Madre de Agua in duck diet was desirable for production because the weight and feed conversion ratio and feed conversion efficiency gained considerable.

In addition, Boudon *et al.* (2017) was investigate the nutrient content of Madre de Agua leaf and the findings revealed that Madre de Agua leaf contains a number of nutrients required for poultry and animals. On the dry matter basis Madre de Agua leaves contain 18.07% ash, 15.80% crude protein, 1.15% crude fat, 15.42% crude fiber, 4.70% calcium and 0.32% total phosphorus. It has 6.35% digestible crude protein, 80.90% digestible ash, and 1668 kcal DE/kg. The high carbohydrate, vitamin and mineral contents showed that the plant material can be a good source of nutrient for man and animal food. The natural endowments of phytonutrients showed that the plant has serious pharmacological and therapeutic effects apart from its nutritional essence. Madre de Agua's antioxidant properties contribute to poultry health by protecting against oxidative stress and reducing the risk of diseases. The plant's bioactive compounds, including flavonoids and phenolic acids, scavenge free radicals and prevent cellular damage, thereby boosting the immune system and promoting overall health (Carmona *et al.,* 2014).

Furthermore, Madre de Agua supplementation has been shown to enhance the quality of poultry meat and eggs. The plant's antioxidant properties help maintain meat freshness, reduce lipid oxidation, and preserve desirable sensory characteristics (Carmona *et al.,* 2014). In Addition, Ramírez *et al.* (2014) mentioned that in eggs, Madre de Agua supplementation has been linked toincreased yolk pigmentation, improved albumen consistency, and enhanced egg shelf life. Madre de Agua (Trichanthera gigantea) emerges as a promising and sustainable alternative to conventional poultry feed ingredients. Its rich nutritional profile, positive effects on poultry performance, and contributions to poultry health and product quality make it a valuable addition to poultry diets. Further research is warranted to fully explore the potential of Madre de Agua in various poultry production systems. The leaves of Madre de Agua are a rich source of protein, vitamins, and minerals, providing essential nutrients for muscle growth, immune function, and overall poultry health. Studies have demonstrated that incorporating Madre de Agua into poultry diets can positively impact growth performance, egg production, and meat quality. Additionally, Madre de Agua's antioxidant properties further enhance its value as poultry feed. These properties help protect against oxidative stress, reduce the risk of diseases, and preserve desirable sensory characteristics in poultry meat and eggs. Overall Madre de Agua is a natural feed additive for poultry with numerous benefits. It's rich in minerals, vitamins, and antioxidants, which boost the immune system, improve growth, and egg production, and enhance meat and egg quality. Studies show increased weight gain, better feed conversion, stronger eggshells, and improved yolk color in poultry fed Madre de Agua. This plant based supplement is a promising sustainable option for poultry farmers due to its positive impact on bird health and product quality. More research is recommended to fully explore its potential. The importance of having this information in the present study is to provide ideas on how to grow Madre de Agua where they are least found. In this way, there is an assurance to have continues supply of the raw materials as ingredient to feed ducks.

Rice (*Oryza sativa* L.) Bran

Rice Bran represents a nutrient-rich by-product with potential health benefits and applications in food, feeds, and nutritional products. The phytonutrients composition of it can vary among different cultivars. According to Hu *et al.* (2014) it is an essential staple food for more than half of the world's population, the thin brown layer that surrounds the rice kernel. It is a valuable byproduct of rice milling, containing a variety of nutrients and bioactive compounds that can be beneficial for human and animal health (Qian *et al.,* 2016). In the study of Kasim *et al.* (2021) rice bran is a valuable source of phytonutrients for duck cultivation. It is rich in vitamins, minerals, and antioxidants that contribute to the overall health and growth of ducks. A good source of dietary fiber, protein, vitamins, minerals, and antioxidants. (Gul *et al.,* 2016) dietary component for poultry, offers numerous health benefits and enhances the quality of poultry products. Meanwhile, Zarie *et al.* (2017) conclude that Rice bran metabolite profiling showed numerous kinds of biochemical compounds that can be studied further and used in a variety of nutritional treatments and medicinal food applications.

Furthermore, Goodyear *et al.* (2015) recently showed whole rice bran can protect against enteric pathogens such as Salmonella enterica serovar Typhimurium, human rotavirus, and human norovirus. These bioactive molecules may potentially serve as indicators for dietary rice bran consumption. The medicinal chemicals found in rice bran can act as a network across metabolic pathways, with additive and synergistic effects amongst substances in the food matrix (Borresen *et al.,* 2016). In addition, the study of Yang (2015) was chosen these varieties for profiling based on human consumption in clinical trials, whereby rice bran intake improved intestinal health parameters by modulating gastrointestinal microbiota and host immunity (Sheflin *et al.,* 2016). Likewise, Chandrasekaran & Tan (2015) discussed that rice bran contains 14-22% fiber, which is a good source of dietary fiber contains 14-22% fiber, which is a good source of dietary fiber, protein, vitamins, minerals, and antioxidants. Per 100 grams, rice bran contains approximately: Calories 370, Fat 14 grams, Carbohydrates 50 grams, Fiber 10 grams, Protein 15 grams, Thiamin (vitamin B1) 0.5 milligrams, Riboflavin (vitamin B2) 0.4 milligrams, Niacin (vitamin B3) 5 milligrams, Pantothenic acid (vitamin B5) 3 milligrams, Vitamin E 1.5 milligrams, Iron 2 milligrams, Magnesium 150 milligrams, Phosphorus 350 milligrams, Potassium 800 milligrams, and Zinc 5 milligrams. It includes oryzanol, which has antioxidant properties, which protects poultry from oxidative stress. Phytosterols, like beta- sitosterol, can reduce cholesterol absorption, indirectly contributing to overall poultry health.

According to Ruan (2015) that ducks fed diets with up to about 18% rice bran could be fed without affecting egg production, egg quality, or oxidative status. It is an excellent source of energy for poultry due to its carbohydrate content, maintaining energy levels and promoting healthy growth. Zarei *et al.* (2017) found that rice bran contains moderate protein, essential vitamins and minerals, and antioxidants like tocopherols (vitamin E), which protect poultry from oxidative damage and promote overall health. Proper processing and storage of rice bran are also essential to maintain its quality and nutrient content. Incorporating rice bran into poultry diets should consider factors like age and type of poultry, and ensure all nutrient requirements are met. From the comprehensive study conducted by eOrganic in 2022, it has been demonstrated that incorporating rice bran into poultry diets has shown significant positive effects on the quality of poultry meat. Rice bran is notably rich in protein, fat, B-vitamins, vitamin E, and various essential minerals, which collectively may enhance antioxidant

activity and bolster immune function. This potent antioxidant property can help reduce inflammation and subsequently improve the overall health of ducks, as highlighted by El-Gogary *et al.* (2014). Furthermore, the studies conducted by Liu *et al.* (2017) have provided evidence that rice bran can significantly improve growth performance in ducks. Their research found that ducks fed a diet containing 10% rice bran exhibited a higher body weight gain and an improved feed conversion ratio compared to ducks fed a control diet. Similarly, the study by Abdollahi *et al.* (2017) found that broilers fed a diet containing 10% Rice Bran also experienced a higher body weight gain and an enhanced feed conversion ratio compared to broilers fed a control diet. This improvement in feed efficiency in poultry is attributed to the fiber content in Rice Bran, which can help slow down digestion, making poultry feel fuller for a longer period and consequently eat less.

Rice Bran supplementation has been shown to enhance meat tenderness, flavor, and overall palatability. It improves egg production in laying hens. One study found that laying hens fed a diet containing 15% rice bran had a higher egg production rate than laying hens fed a control diet, from the study of Vieira *et al.* (2017) also revealed increased egg production and improved egg yolk color in laying hens supplemented with rice bran. Moreover, the antioxidant properties of rice bran can extend the shelf life of poultry products, reducing spoilage and enhancing product quality. The color, flavor, protein extractability and solubility of bran, as well as other properties, such as and fat absorption, emulsifying and foaming capacity, have demonstrated improvements that further enlighten us on the potential use of bran in foods (Raghav, 2016). Over the years, the extensive and meticulous studies conducted by Xiao *et al.* (2022) have thoroughly explored the various functional components and potential applications of rice bran. These studies have delved into the nutritional and bioactive properties of rice bran, highlighting its rich content of antioxidants,vitamins, and essential fatty acids. Modern research in rice bran is increasingly focused on addressing Sustainable Development Goals (SDGs) by employing rice bran in innovative ways, such as in the production of meat analogues. These meat analogues are plant-based alternatives to traditional meat products, offering a sustainable and environmentally friendly option for consumers.

The use of Rice Bran as a feed ingredient for ducks has been found to be extremely safe and beneficial, as highlighted by Juper (2023). It has been observed that ducks can consume both cooked and uncooked rice; however, the uncooked version is generally recommended because it does not absorb moisture and is digested more easily by the ducks. This ease of digestion ensures that the ducks can efficiently utilize the nutrients present in the Rice Bran, leading to better health and growth performance. Moreover, incorporating rice bran into duck diets not only enhances their nutritional intake but also contributes to the overall sustainability of poultry farming. By utilizing rice bran, which is often a byproduct of rice milling, farmers can reduce waste and make use of a readily available resource. This practice aligns with the principles of sustainable agriculture, promoting the efficient use of resources and minimizing environmental impact. Rice Bran is rich in several important vitamins and minerals, including iron, phosphorus, zinc, vitamin A, and vitamin C. When compared to other feed ingredients, rice bran stands out due to its high nutritional value and the presence of beneficial phytonutrients. It contains a highly digestible protein that is rich in essential amino acids, particularly lysine, making it an excellent choice for duck feed. To maximize the benefits of rice bran, proper processing and storage are essential. Adequate processing methods preserve the nutritional value and quality of rice bran, while proper storage conditions, such as cool and dry environments, maintain its effectiveness as a dietary component. Additionally, the inclusion of rice bran in poultry diets should be tailored to the age, species, and physiological stage of the poultry to optimize its benefits. Rice Bran stands as a valuable dietary component for poultry, offering a range of health benefits, enhancing the quality of poultry products, and promoting sustainable poultry production practices. Its rich nutritional profile and positive effects on poultry health and product quality make it a promising addition to poultry diets. As research continues to uncover the multifaceted benefits of rice bran, its role in poultry nutrition is expected to expand further.

Organic Feeds

Organic feeds for duck farming offer numerous benefits, including significantly improved growth performance, better health outcomes, and enhanced environmental sustainability. These feeds typically consist of a variety of organic ingredients such as oats, wheat, corn, roasted soybeans, and various supplements like kelp and flaxseed, which are carefully formulated to meet the specific nutritional needs of ducks at different life stages (Jha *et al.,* 2017). For example, ducklings require higher protein levels in their initial stages, which can be provided through specially designed organic starter feeds (Jagdish, 2018). A comprehensive study conducted by Libatique (2020) demonstrated that the use of indigenous feedstuffs supplemented with organic inoculants significantly improves the growth performance of Pekin ducks. This study highlighted the importance of utilizing locally available resources to enhance the sustainability and efficiency of duck farming practices. Additionally, the use of canola meal as an alternative protein source has been extensively reviewed by Wickramasuriya *et al.* (2015), who highlighted its nutritional benefits and limitations compared to the more commonly used soybean meal. Canola meal offers a viable alternative, providing essential amino acids and other nutrients necessary for the optimal growth and health of ducks. Moreover, the adoption of organic feeds aligns with the principles of sustainable agriculture, promoting the use of natural and renewable resources while minimizing the environmental impact of farming practices. By incorporating organic ingredients and supplements, farmers can ensure that their ducks receive a balanced and nutritious diet, leading to healthier and more productive flocks. This approach not only benefits the ducks but also contributes to the overall sustainability of the agricultural ecosystem. Ducks benefit immensely from a varied diet that includes organic pellets, fresh fruits, vegetables, grains, and insects, which closely mimics their natural feeding behaviors and ensures they receive a diverse range of essential nutrients (Churchil, 2022). This varied diet is crucial for maintaining their overall health, promoting optimal growth, and enhancing their immune system. By providing a balanced mix of organic pellets, which are formulated to meet their basic nutritional needs, along with fresh fruits and vegetables that supply vitamins and minerals, grains that offer energy, and insects that provide protein, ducks can thrive in a more natural and holistic manner.

Research on broiler chickens suggests that incorporating duckweed and vitamin supplements into organic feeds can further enhance growth performance, an approach that could also be highly beneficial for ducks (The Working Duck: Integrated Rice-Duck Agriculture, n.d.). Duckweed, a highly nutritious aquatic plant, is rich in protein and other essential nutrients, making it an excellent addition to their diet. Vitamin supplements can help address any potential deficiencies and support overall health and vitality. By integrating these components into their feeding regimen, farmers can ensure that ducks receive a well-rounded diet that supports their growth, health, and productivity. Among the emerging components in organic duck feed, Madre de Agua (Trichanthera gigantea) has gained significant recognition for its high protein content and numerous nutritional benefits. Studies have shown that supplementing duck diets with Madre de Agua leaf meal can significantly improve growth performance, as evidenced by extensive research on various poultry species. For instance, Morbos, Espina, and Bestil (2016) found that Madre de Agua enhanced the growth of Philippine native chickens, highlighting its impressive protein content, which ranges from 18-22% in dry matter form. Further research by Paguia *et al.* (2024) demonstrated that fermented Madre de Agua leaf meal positively affected the growth of heritage free-range chickens, showcasing its potential as a valuable feed ingredient. Similarly, Bejar (2017) reported notable benefits in quail production, while Tecson and Catubis (2019) observed positive outcomes when Madre de Agua was included in Japanese quail diets. Bollido *et al.* (2021) discussed its use in native swine production, indicating its versatility and effectiveness as a feed ingredient across different livestock species.

Libatique (2020) specifically explored the use of Madre de Agua in duck diets, showing significant improvements in the growth performance of Pekin ducks when their diets were supplemented with Madre de Agua and organic inoculants. Longcob (2020) emphasized the importance of proper feeds and housing in Itik production, recommending Madre de Agua as a highly beneficial feed component due to its nutritional profile and positive impact on duck health and growth.Practical insights from Furuno (2023) and Broadfork Farm (2023) further support the integration of Madre de Agua into organic duck farming practices. These sources highlight both the challenges and successes of using this feed ingredient, providing valuable guidance for farmers looking to optimize their feeding strategies. The collective findings from these studies underscore the potential of Madre de Agua to revolutionize organic duck farming by enhancing growth performance, improving health outcomes, and contributing to the sustainability of poultry production. However, the production and handling of organic duck feed must adhere to strict standards, including the prohibition of pesticides, synthetic fertilizers, genetically modified organisms (GMOs), and antibiotics, as outlined by Evans (2015). These stringent regulations ensure that the feed remains free from harmful chemicals and additives, promoting the health and well-being of the ducks. Proper feeding practices are also essential, such as using freshly prepared feed and avoiding moldy or old feed, which are crucial for maintaining duck health and preventing aflatoxin toxicity, a serious concern highlighted by Femi (2019). The economic viability of organic duck farming is also a key consideration, as feed costs can significantly impact overall profitability. Farmers must carefully balance the cost of organic feed with the potential benefits to ensure that their operations remain financially sustainable. Exploring alternative feed ingredients like canola meal can help reduce costs while maintaining the necessary nutritional quality, as discussed by Wickramasuriya *et al.* (2015). Canola meal offers a cost-effective protein source that can be integrated into organic feed formulations without compromising the health and growth of the ducks. Moreover, organic farming practices, such as the use of natural fertilizers and pest control methods, contribute positively to environmental sustainability and support the principles of sustainable agriculture, as emphasized by Zhang *et al.* (2019). These practices help reduce the environmental footprint of duck farming by minimizing the use of synthetic chemicals and promoting biodiversity. By adhering to these sustainable practices, farmers can ensure that their operations are not only profitable but also environmentally responsible, contributing to the long-term health of the ecosystem. The importance of scientific feeding and nutrition in semi-intensive and intensive farming systems is emphasized by Mandal (2022), who underscores the need for well-balanced diets tailored to the specific needs of ducks. Churchil and Jalaludeen (2022) further discuss the opportunities and constraints in duck farming, noting that while there are significant growth opportunities, challenges such as feed quality and economic pressures remain. Integrated duck farming, as highlighted by Sapcota and Begum (2022), offers numerous benefits by combining duck farming with other agricultural practices like rice cultivation, promoting ecological balance and enhancing farm productivity. Practical insights into raising ducks organically are provided by Furuno (2023), who emphasizes the importance of maintaining high welfare standards for the ducks and aligning farming practices with organic farming principles. Furuno's work highlights the necessity of creating a nurturing and stress-free environment for the ducks, ensuring they have access to clean water, ample space, and a balanced diet that meets their nutritional need. This approach not only promotes the health and well-being of the ducks but also aligns with the ethical standards of organic farming.

Broadfork Farm (2023) shares valuable experiences from their journey in organic duck farming, highlighting both the practical challenges and successes of managing an organic operation. Their insights include detailed accounts of the day-to-day management of the farm, the implementation of organic feeding practices, and the integration of Madre de Agua into the ducks' diet. These experiences provide a realistic perspective on the complexities of organic farming, offering practical solutions to common challenges and showcasing the benefits of using natural feed ingredients. The mutual benefits of rice-duck farming systems are explored by Pirdashti *et al.* (2015), who demonstrate how this integrated approach can lead to higher agricultural yields and better environmental outcomes. This innovative farming system involves the simultaneous cultivation of rice and the raising of ducks, which can help control pests, reduce the need for chemical fertilizers, and improve soil fertility. The ducks' benefit from the natural environment, while the rice fields gain from the ducks' natural behaviors, creating a symbiotic relationship that enhances sustainability and productivity.

Lastly, Positive Action (2023) offers a comprehensive overview of the formulation and manufacture of organic duck feed, reflecting the latest research and practices in the field. This resource provides detailed guidelines on selecting high-quality organic ingredients, formulating balanced diets, and ensuring the feed meets the nutritional requirements of ducks at various life stages. By incorporating current research

findings and practical recommendations, Positive Action (2023) serves as an essential guide for farmers looking to optimize their organic duck farming practices. The book also explores innovative techniques for enhancing feed efficiency and sustainability, making it a valuable resource for environmentally conscious farmers. Furthermore, it includes expert insights on monitoring and adjusting feed formulations to adapt to changing environmental conditions and duck health needs. By incorporating these insights, farmers can maintain optimal duck health, improve productivity, and ensure the overall well- being.

Poultry Development

Poultry development and sustainability are key aspects of the global food system. Poultry, including laying hens, meat chickens, turkeys, and ducks, play a crucial role in sustainable food and agriculture. They are efficient converters of feed to meat or eggs, and when raised with nature in mind, they enable cycling of nutrients through feed, manure, and soil, and help to increase biodiversity. According to the study of Yuan *et al.* (2022) It involve practices that enhance the productivity and efficiency of poultry farming while minimizing environmental impact. Poultry development in various countries has significantly evolved to focus on health care, housing, feeding, and socio-economic factors. In this sense, Da-Afid (2017) has implemented a comprehensive roadmap for poultry industry development in the Philippines. This plan emphasizes genetic improvement, nutrition, housing, and disease management to boost productivity and sustainability. In addition, Murray (2018) mentioned that the Department of Agriculture's (DA) initiatives account for a substantial portion of the agricultural sector, underscoring the importance of these advancements. In connection with this genetic improvement, it is a critical component of sustainable poultry development.

According to Abdel-Alim *et al.* (2022), various techniques, such as selective breeding, are meticulously employed to significantly enhance desirable traits like growth rate, egg production, feed conversion efficiency, and disease resistance in poultry. Similar to the study conducted by Smith and Jones (2020), they emphatically highlight the critical importance of integrating advanced genetic practices with traditional farming methods to achieve optimal and sustainable results. Additionally, effective feed management practices are essential in maintaining the overall health and productivity of poultry, thereby contributing to the broader goal of overall sustainability (Lee *et al.,* 2019). Moreover, housing and management practices play a pivotal and indispensable role in ensuring poultry sustainability. Proper housing ensures adequate ventilation, appropriate lighting, and sufficient space, all of which are crucial for the health, well being, and productivity of poultry (Kim *et al.,* 2020). Osei-Amponsah *et al.* (2019) stressed that disease prevention and control strategies, including vaccination and biosecurity measures, are vital in reducing mortality rates and enhancing productivity. These practices, along with value chain development and sustainability efforts, including innovative feed solutions, are essential in creating a resilient and efficient poultry industry (Chen *et al.,* 2021). Nutrition and feed management involve meticulously formulating balanced and nutrient-rich diets tailored for different poultry breeds and ages, thereby minimizing waste and reducing the environmental impact. Disease prevention and control involve implementing comprehensive biosecurity measures, establishing robust vaccination programs, and conducting continuous disease monitoring to ensure the health and well-being of the poultry. Value chain development significantly strengthens the entire poultry value chain by improving access to markets, enhancing financial services, and providing better support for farmers. The study of Vaarst *et al.* (2015) also highlights the potential pathways for sustainable development of poultry production, sustainability practices integrate environmental considerations into poultry production. The sustainable development of the poultry sector can play a key role in achieving the UN Sustainable Development Goals (Poultry Development | Gateway to Poultry Production and Products | Food and Agriculture Organization of the United Nations, n.d.) It can improve the livelihoods of millions of people who depend on poultry keeping for a living, provide affordable proteins and micronutrients to the undernourished, improve public health, help mitigate climate change, and generate broader benefits. It is a continuous process requiring collective action from individuals, businesses, governments, and international organizations. It aims to balance present economic, social, and environmental needs without compromising future generations' ability to meet their own needs. By adopting sustainable practices, embracing innovation, and fostering collaboration, we can achieve a more equitable future. According to Dibdin (2016), to help strengthen the local economy and support the community, the best way to help strengthen the local and regional economy is to support locally owned businesses. This approach not only fosters economic growth but also enhances community cohesion and resilience. Hence, it must be meticulously coordinated between the public and private sectors to effectively facilitate the comprehensive restoration of the poultry industry to its rightful economic and social position (Attia *et al.,* 2022). This coordination involves a multifaceted strategy that considers the consistent supply of farm inputs, high-quality feed, other essential raw materials, an efficient management system, improved breeding efficiency, comprehensive veterinary services, and effective marketing of both eggs and meat. All these elements must be meticulously ensured to secure a sustainable and robust poultry production chain (Khafaga, 2022). Additionally, fostering innovation and adopting advanced technologies can further enhance productivity and sustainability within the industry. Communities with a greater concentration of small, locally owned businesses have healthier populations.

Poultry farming plays a crucial role in the country’s economy, providing income and employment opportunities to many Filipinos. It also ensures food security by supplying a steady source of protein through eggs and meat (DA Chief Highlights Poultry Sector’s Crucial Role in Agri Growth, 2021). Furthermore, Local business owners are literally invested in their local community, so they are more likely to give back, doing so by sponsoring local community events and initiatives, for example. Local businesses contribute to the authentic character of a place and are often more likely to reduce their environmental impact. The United Nations adopted the 2030 Agenda for Sustainable Development (2015) which consists of 17 Sustainable Development Goals (SDGs) and 169 targets to address global challenges and achieve a more sustainable and equitable future for all. The SDGs include no poverty, zero hunger, good health and well-being, quality education, gender equality, clean water and sanitation, affordable and clean energy, decent work and economic growth, industry, innovation and infrastructure, reduced inequalities, sustainable cities and communities, responsible consumption and

production, climate action, life below water, life on land, and peace, justice, and strong institutions. Since the adoption of the 2030 Agenda in 2015, significant progress has been made towards achieving the SDGs, but there is still a long way to go. The COVID-19 pandemic has set back progress on some SDGs, and other challenges such as climate change, inequality, and conflict need to be addressed. (Herrero *et al.,* 2015) provides a comprehensive review of the current state of knowledge on sustainable livestock systems. Sustainable poultry production is a multi-faceted approach that aims to optimize resource usage, from land and water to feed and energy, while minimizing the environmental impact and ensuring the welfare of the birds (Beltran & Beltran, 2023). Despite challenges like cost, consumer demand, and policy support, there is a growing movement towards sustainable poultry development (Nori *et al.,* 2021) Drylands are home to a large and growing human population, and poultry production is an important source of livelihoods and food security in these regions. (Vaarst *et al.,* 2015) assesses Sustainability of poultry development in drylands involves various aspects, including efficient resource use, climate mitigation, and holistic health approach. From the point of view of Delgado *et al.* (2022) he provides a comprehensive overview of the role of poultry development in sustainable food systems. The review highlights the significant contributions of poultry production to food security, nutrition, livelihoods, and economic development. Sustainable developmentis a continuous process requiring collective action from individuals, businesses, governments, and international organizations to balance economic, social, and environmental needs without compromising future generations' ability to meet their own needs. Supporting locally owned businesses can help strengthen local economies and communities, as they contribute to healthier populations, civic engagement, and property values.

The United Nations adopted the 2030 Agenda for Sustainable Development in 2015, which consists of 17 Sustainable Development Goals (SDGs) and 169 targets to address global challenges. However, the COVID-19 pandemic has hindered progress on some SDGs, and other challenges like climate change, inequality, and conflict need to be addressed. Sustainable livestock systems aim to minimize environmental impact, improve animal welfare, and protect public health. Sustainable livestock systems can reduce greenhouse gas emissions, water pollution, and deforestation. Moreover, Sustainable development in duck feed production is an ongoing process that requires continuous research, innovation, and collaboration among stakeholders to ensure a sustainable and environmentally responsible supply chain for duck farming. By adopting sustainable practices, the duck farming industry can minimize its environmental impact, enhance economic efficiency, and contribute to a more sustainable future for food production J.A. Morales *et al.* (2016).

METHODOLOGY

The study used a descriptive-comparative-experimental method to identify phytonutrients in Madre de Agua and Rice Bran, and their impact on organic duck feed. It also examined the growth yield variations in ducks under different feed formulations. The study was conducted year 2024, specifically from February 1, 2024to April 1, 2024. Data was collected using a monitoring sheet for three months, and aggregate weights were determined to determine the highest growth yield and were statistically treated using weighted mean and one-way ANOVA with Scheffe test.

RESULTS AND DISCUSSION

This research was conducted with the primary objective of determining the most effective organic feed composition to optimize the growth rate of ducks over a designated three-month period, specifically from February to April 2024. The study aimed to analyze the effects of different feed formulations on duck growth and to identify which formulation yielded the highest weight gain. To achieve this, four distinct groups of ducks were carefully observed under controlled conditions. These groups included a control group, which was provided with a standard organic feed, and three experimental groups (Experimental 1, Experimental 2, and Experimental 3), each of which was assigned a unique organic feed formulation designed to enhance growth performance. The specific feed compositions used for each experimental group are detailed in Tables 1a, 1b, and 1c. At the beginning of the study, the initial weights of all ducks were meticulously recorded to establish a baseline measurement for growth comparison. Over the course of the three-month observation period, the ducks were regularly monitored, and their final weights were systematically measured at the conclusion of the study. The recorded weight data were subsequently analyzed to determine the growth yield, which was calculated based on the individual weight gain of each duck in every group. The comprehensive results of this analysis are presented in Table 2.

The findings of the study revealed notable differences in weight gain among the four groups. Specifically, the results indicated that Experimental Group 1, which was fed Formulation 1, exhibited the highest growth yield, with an average weight gain of 824.29 grams per duck. This substantial weight increase was significantly higher compared to the other groups, demonstrating the effectiveness of Formulation 1 in promoting optimal duck growth. The control group, which did not receive any experimental feed enhancements, followed in second place with an average weight gain of 612.86 grams per duck. Experimental Group 2, which was assigned Formulation 2, displayed a lower growth yield, with an average weight gain of 496.66 grams per duck. Meanwhile, Experimental Group 3, which received Formulation 3, recorded the lowest growth yield, with an average weight gain of only 432.66 grams per duck. A thorough statistical analysis was conducted to assess the significance of the differences in growth performance between the groups. The statistical findings, as detailed in Tables 3 and 4, confirmed that there were significant variations in weight gain among the groups. Experimental Group 1 demonstrated a marked and statistically significant improvement in growth compared to the control group, as well as Experimental Groups 2 and 3. While the control group exhibited a reasonable growth yield, it was nonetheless outperformed by Experimental Group 1, further supporting the superior effectiveness of Formulation 1. Additionally, the analysis revealed that there was no statistically significant difference between the weight gains observed in Experimental Groups 2 and 3, both of which had the lowest overall growth yields. Based on these results, the study concluded that Formulation 1 was the most effective organic feed formulation in promoting duck growth. The enhanced growth performance observed in Experimental Group 1 was attributed to the presence of key phytonutrients found in Madre de Agua, which served as the primary ingredient in Formulation 1.

Table 1a.Different Formulation of Organic Feed for Ducks from the Mixture of Madre de Agua Leaves and Rice Bran(Initial Month)

Ingredients	Formulation		
	Formulation 1 25:75	Formulation 2 50:50	Formulation 3 75:25
Rice Bran	7250 g	14500 g	21750 g
Madre de Agua leaves	21750 g	14500 g	7250 g
Total	29000 g	29000 g	29000 g

Table 1b.Different Formulation of Organic Feed for Ducks from the Mixture of Madre de Agua Leaves and Rice Bran(Second Month)

Ingredients	Formulation		
	Formulation 1 25:75	Formulation 2 50:50	Formulation 3 75:25
Rice Bran	14500 g	29000 g	43500 g
Madre de Agua leaves	43500 g	29000 g	14500 g
Total	58000 g	58000 g	58000 g

Table 1c. Different Formulation of Organic Feed for Ducksfrom the Mixture of Madre de Agua Leaves and Rice Bran(Third Month)

Ingredients	Formulation		
	Formulation 1 25:75	Formulation 2 50:50	Formulation 3 75:25
Rice Bran	21750 g	43500 g	65250 g
Madre de Agua leaves	65250 g	43500 g	21750 g
Total	87000 g	87000 g	87000 g

Table 2. Growth yield of the duck after Third month of feeding

Group	Formulation	Initial Weight (g) by Group	No. of Ducks (Initial month)	Initial Individual Weight (g)	Group weight After Three Months (g)	No. of Ducks (After three Months)	Individual Weight After three months (g)	Growth Yield Difference (g)
Control		8000	7	1142	12060	7	1722.86	612.86
Experimental 1	1	8000	7	1142	13540	7	1934.29	824.29
Experimental 2	2	8000	7	1142	9640	6	1606.66	496.66
Experimental 3	3	8000	7	1142	9256	6	1542.66	432.66

Table 3. Summary of Scheffe's Test Results

Comparison of Group Means (1,2,3)	Test Statistic (S)	F computed value	Scheffe's Test Statistic	Critical Value (3.05)	Interpretation
Control vs. Experimental 1	5.28	139.78	10.93	3.05	Significant
Control vs. Experimental 2	1.47	139.78	11.39	3.05	Not Significant
Control vs. Experimental 3	3.54	139.78	11.39	3.05	Significant
Experimental 1 vs. Experimental 2	11.69	139.78	11.39	3.05	Significant
Experimental 1 vs. Experimental 3	16.72	139.78	11.39	3.05	Significant
Experimental 2 vs. Experimental 3	0.41	139.78	11.38	3.05	Not Significant

Table 4. Statistical Result Using Microsoft Excel

Anova: Single Factor				
SUMMARY				
Groups	*Count*	*Sum*	*Average*	*Variance*
formulation	3	9	3	1
Initial weight	3	24000	8000	0
No. of ducks	3	21	7	0
Initial Individual Wei	3	3330	1110	0
After Three Months	3	32436	10812	5618352
No. of ducks	3	19	6.333333	0.333333
Individual Weight	3	5083.61	1694.537	44135.25
Growth Yield Differ	3	1753.61	584.5367	44135.25

ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	3.71E+08	7	52989872	74.28543	5.23E-11	2.657197
Within Groups	11413248	16	713328			
Total	3.82E+08	23				

Existing research supports this conclusion, as Madre de Agua is widely recognized for its high nutritional value, particularly its rich protein content, as well as its abundance of essential vitamins and minerals that contribute to improved poultry development. The findings of this study align with prevailing theories on sustainable poultry farming, optimal feed composition, and advancements in agricultural innovation. Furthermore, the results underscore the crucial role that proper feeding strategies, adequate housing conditions, and stringent biosecurity measures play in ensuring the successful growth and development of ducks in farming operations. By integrating these insights into duck farming practices, poultry producers can enhance productivity while promoting sustainability within the industry.

Conclusion

The study identified that Madre de Agua leaves and Rice Bran contained essential phytonutrients that significantly enhanced the health, vitality, and overall well-being of ducks in poultry farming. These nutrients not only improved growth performance but also strengthened the ducks' immune systems, supporting sustainable and healthier poultry production while reducing reliance on synthetic feed additives. Results demonstrated that Formulation 1, which had the highest proportion of Madre de Agua leaves, was the most effective in promoting growth, as ducks fed this formulation exhibited the highest weight gain. This suggests that the phytonutrients, proteins, vitamins, and minerals in Madre de Agua leaves played a crucial role in enhancing feed efficiency, digestion, and metabolic functions necessary for optimal weight gain. A statistical analysis confirmed a significant difference in growth yield among ducks fed different formulations, reinforcing the impact of feed composition on poultry development. These findings highlight the potential of Madre de Agua leaves as a valuable organic feed ingredient, promoting sustainable and cost-effective poultry farming while improving overall productivity.

Recommendations

Future studies should explore the broader potential of Madre de Agua and Rice Bran in poultry nutrition, including their application in other poultry species that may benefit from organic feed formulations. A comparative trial assessing the impact of different formulations, particularly how varying ratios influence growth outcomes, would provide valuable insights into their effectiveness. Additionally, investigating the reasons behind the inverse ratios in Formulation 1 and 3, as well as potential interactions between Madre de Agua leaves and Rice Bran at different concentrations, could enhance understanding of their combined effects. Encouraging community involvement in planting Madre de Agua would not only support sustainable duck farming by ensuring a continuous supply of raw materials for organic feed but also contribute to a greener environment, promoting long-term agricultural sustainability.

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