GIANT TARO (*Alocasia macrorrhizos Linn.*) MEAL: EFFECTS ON HOG GROWTH AND FEED EFFICIENCY

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Abstract

This comprehensive study investigates the effects of substituting commercial feeds with Giant Taro (Alocasia macrorrhizos Linn.) meal on the growth performance, feed conversion efficiency, and meat quality of hogs, accompanied by an economic and nutritional analysis. The experiment utilized a Complete Randomized Design (CRD) involving 12 pig weanlings assigned to four distinct treatment groups, each replicated three times. The treatments comprised a control group receiving 100% commercial feeds and three experimental groups with 11%, 15%, and 19% Giant Taro Meal (GTM) substituted for commercial feeds. Over a 90-day feeding period, metrics such as weight gain, feed consumption, feed conversion ratio (FCR), and backfat thickness were meticulously monitored. Additionally, a sensory evaluation of meat quality was conducted with a panel of 27 untrained tasters. Economic assessments, including net income and Return Above Feed and Treatment Cost (RAFTC), were also computed to evaluate the viability of GTM as a feed alternative. The results indicated a decline in feed conversion efficiency and economic returns with increased GTM levels, despite the meat quality parameters remaining unaffected. This study concludes that while GTM presents a potential cost-saving alternative, its economic and nutritional trade-offs may limit its use in large-scale commercial operations.

Keywords and phrases: *Giant Taro Meal, Hog Growth Performance, Feed Conversion Efficiency, Meat Quality, Alternative Livestock Feeds*

Introduction

The global demand for meat products continues to surge, driven by population growth and rising incomes, particularly in developing countries (Smith & Johnson, 2019). As a result, livestock producers face escalating costs for commercial feeds, which constitute a significant portion of production expenses. This economic pressure has spurred interest in alternative feed ingredients that are locally available, cost-effective, and nutritionally viable. One such potential alternative is Giant Taro (Alocasia macrorrhizos Linn.), a tropical plant traditionally used as a staple food in many regions of Asia and the Pacific (Johnson & Nguyen, 2018).

Giant Taro, also known as "Badjang" in the Philippines, is recognized for its robust growth and high yield of biomass, making it a promising candidate for animal feed (Lee & Park, 2021). The plant's corms and leaves are rich in carbohydrates, vitamins, and minerals, which can contribute to the nutritional needs of livestock. However, the high fiber content and presence of anti-nutritional factors such as calcium oxalate crystals pose

challenges to its widespread adoption in livestock diets (Martinez et al., 2020). These factors necessitate careful processing and appropriate inclusion levels to ensure the feed's safety and efficacy.

Previous studies have explored the use of Giant Taro in animal feeds, with varying results. For instance, research by Gonzalez and Alvarez (2017) highlighted the potential economic benefits of using GTM as a feed ingredient, particularly in reducing overall feed costs. However, the study also noted a reduction in growth performance and feed conversion efficiency, which could negate the cost savings. Another study by Johnson and Nguyen (2018) emphasized the need for further research to optimize the processing and inclusion levels of GTM to maximize its benefits while minimizing adverse effects.

This study aims to contribute to this growing body of knowledge by systematically evaluating the effects of feeding varied levels of GTM on the growth performance, feed conversion efficiency, and meat quality of hogs. Additionally, the study includes an economic analysis to assess the feasibility of GTM as a commercial feed substitute. By providing comprehensive data and insights, this research seeks to inform livestock producers, feed manufacturers, and policymakers about the potential and limitations of GTM in sustainable livestock production.

Methods

The study was conducted from February to May 2023 at a livestock research facility in Gubat, Roxas, Zamboanga del Norte, Philippines. The experimental setup followed a Complete Randomized Design (CRD), which is widely recognized for its ability to minimize bias and ensure the reliability of results in agricultural research (Lee & Park, 2021). Twelve weaned piglets of the same breed and age were randomly assigned to one of four treatment groups. Each group was housed in a separate pen, with three replicates per treatment, ensuring adequate sample size for statistical analysis.

The treatment groups were as follows:
T0 (Control): 100% Commercial Feeds
T1: 11% Giant Taro Meal (GTM) + 89% Commercial Feeds
T2: 15% GTM + 85% Commercial Feeds
T3: 19% GTM + 81% Commercial Feeds

These inclusion levels were selected based on previous studies that identified the potential of GTM to replace a portion of commercial feeds without significantly compromising the nutritional value of the diet (Smith & Johnson, 2019). The commercial feeds used in this study were standard formulations commonly available in the Philippine market, designed to meet the nutritional requirements of growing pigs.

The Giant Taro plants were sourced from local farms near the research facility. To prepare the GTM, the corms were first peeled and diced into small pieces. This was followed by a rigorous boiling process to reduce the content of calcium oxalate crystals, which are known to cause irritation and reduce feed palatability (Johnson & Nguyen,

2018). The boiling water was replaced multiple times to ensure maximum removal of these anti-nutritional factors. After boiling, the taro pieces were sun-dried for three days, a method that not only reduces moisture content but also improves the shelf life of the meal. Once dried, the taro pieces were ground into a fine meal using a commercial-grade grinder. The GTM was then mixed with the commercial feeds at the specified ratios for each treatment group.

Each piglet was housed in a concrete pen measuring 1 meter by 0.75 meters, providing a total floor space of 0.75 square meters per animal. This space allowance aligns with recommendations for growing pigs, ensuring adequate room for movement and reducing stress (Martinez et al., 2020). The pens were equipped with individual feeding troughs and automatic nipple drinkers, ensuring constant access to clean water.

The feeding regimen consisted of two daily feedings, at 6:00 AM and 4:00 PM. The feed rations were manually weighed and distributed to each piglet according to their respective treatment group. The wet feeding method was employed, which involved mixing the feeds with water to improve palatability and reduce feed dust, which can cause respiratory issues in pigs (Lee & Park, 2021). Water intake was monitored daily to ensure that the animals were adequately hydrated, especially given the high fiber content of the GTM, which could increase their water requirements.

Growth Performance: The primary data collected included initial and final body weights, measured using a calibrated digital scale. These measurements were taken every 15 days to track the Average Daily Gain (ADG) over the study period. Feed consumption was recorded daily by weighing the feed offered and the leftovers after each meal, allowing for the calculation of Feed Conversion Ratio (FCR) and Feed Conversion Efficiency (FCE).

Meat Quality: Post-mortem, the meat quality was assessed through backfat thickness measurements and a sensory evaluation. Backfat thickness was measured at three anatomical points—opposite the first rib, last rib, and last lumbar vertebra—using a vernier caliper. The sensory evaluation was conducted by a panel of 27 untrained tasters, who rated the meat samples on parameters such as lean color, odor, firmness, tenderness, taste, and juiciness using a Likert scale (Gonzalez & Alvarez, 2017).

Economic Analysis: The economic feasibility of using GTM as a feed substitute was assessed by calculating the net income and Return Above Feed and Treatment Cost (RAFTC). These metrics provide insights into the cost-effectiveness of each treatment, considering both the costs of feed and the market value of the produced pork.

The collected data were analyzed using Analysis of Variance (ANOVA) to determine the significance of differences between treatments. Post-hoc T-tests were conducted to compare pairs of means where significant differences were detected. The statistical significance threshold was set at $p < 0.05$. The analyses were performed using SPSS software, version 25.0, which is widely used for agricultural research due to its robustness and reliability (Martinez et al., 2020).

Ethical Considerations

Ethical considerations were central to the study's design and implementation. Informed consent was obtained from all participants, ensuring they were fully aware of the study's purpose, procedures, and potential risks. Data confidentiality was strictly maintained, with all identifying information anonymized in the analysis and reporting. The study adhered to the ethical guidelines set forth by the institutional review board and relevant national and international regulations.

Results

Growth Performance

The growth performance of the hogs across the treatment groups showed distinct patterns. The control group (T0) consistently exhibited the highest Average Daily Gain (ADG) throughout the study, with an average gain of 0.7 kg per day. This superior growth rate is likely due to the balanced nutrient profile of the commercial feeds, which are specifically formulated to support optimal growth in pigs (Smith & Johnson, 2019).

In contrast, the GTM-substituted groups displayed a gradual decline in ADG as the level of GTM increased. T1 (11% GTM) recorded an ADG of 0.65 kg, T2 (15% GTM) had 0.63 kg, and T3 (19% GTM) had the lowest ADG at 0.60 kg. These results suggest that the higher fiber content in GTM may have impeded nutrient absorption, leading to slower growth rates (Martinez et al., 2020).

Statistical analysis confirmed significant differences in weight gain between the control group and the GTM-substituted groups on days 30 and 60 ($p < 0.05$). However, by day 90, the differences were no longer statistically significant, indicating that the negative impact of GTM on growth performance may diminish over time as the pigs adapt to the new diet (Lee & Park, 2021).

Feed Conversion Efficiency (FCE) and Feed Conversion Ratio (FCR)

The FCE and FCR are critical indicators of how efficiently the pigs converted feed into body weight. The control group (T0) demonstrated the highest feed conversion efficiency, requiring 2.24 kg of feed to produce 1 kg of body weight. This efficiency reflects the high digestibility and nutrient availability of the commercial feeds (Smith & Johnson, 2019).

As the level of GTM in the diet increased, the feed conversion efficiency decreased. T1 required 2.30 kg of feed per kg of body weight, T2 required 2.40 kg, and T3 required 2.51 kg. The decrease in FCE with higher GTM levels suggests that the energy from GTM is less readily available or is utilized less efficiently, possibly due to the higher fiber content and the presence of anti-nutritional factors (Martinez et al., 2020).

Meat Quality

The sensory evaluation revealed no significant differences in the lean color, odor, firmness, tenderness, taste, and juiciness of the meat across all treatment groups. This finding indicates that GTM does not adversely affect the sensory properties of pork, making it a viable alternative feed ingredient in terms of meat quality (Gonzalez & Alvarez, 2017).

However, backfat thickness, a key indicator of meat quality, varied among the treatment groups. The control group (T0) had the thinnest backfat at 1 cm, while T3, which had the highest level of GTM, recorded the thickest backfat at 2 cm. The increase in backfat thickness with higher GTM levels suggests that the energy from GTM may be more readily stored as fat rather than being utilized for muscle growth (Lee & Park, 2021).

Discussion

Growth Performance and Nutritional Implications

The study's findings indicate that while GTM can partially replace commercial feeds in hog diets, it leads to a reduction in growth performance and feed conversion efficiency. These outcomes are consistent with previous research that has highlighted the challenges of using high-fiber feed ingredients in swine diets (Martinez et al., 2020). The reduced growth rates and feed efficiency observed in the GTM-substituted groups can be attributed to the lower digestibility of the diet, which in turn limits the availability of essential nutrients required for optimal growth.

From a nutritional perspective, the high fiber content in GTM, although beneficial for gut health, may hinder the absorption of other nutrients, particularly energy and protein, which are critical for growth (Johnson & Nguyen, 2018). The presence of anti-nutritional factors such as calcium oxalate crystals further exacerbates this issue by reducing feed palatability and potentially causing irritation to the gastrointestinal tract (Smith & Johnson, 2019).

To enhance the nutritional value of GTM, future studies could explore different processing methods, such as fermentation or enzyme treatment, to reduce fiber content and improve nutrient bioavailability. Additionally, blending GTM with other locally available feed ingredients that are rich in protein and energy could create a more balanced diet that supports better growth performance.

Economic Viability

The economic analysis revealed that the control group (T0) generated the highest net income and RAFTC, indicating that 100% commercial feeds remain the most economically viable option under the conditions of this study. However, GTM did provide some cost savings in terms of feed expenses, particularly in treatments T1 and T2, which used lower inclusion levels of GTM. Despite these savings, the reduced feed conversion

efficiency and lower growth rates ultimately led to lower overall profitability for the GTM-substituted groups (Gonzalez & Alvarez, 2017).

These findings suggest that while GTM may be a viable option for small-scale or backyard hog producers looking to reduce feed costs, it may not be suitable for large-scale commercial operations where maximizing growth performance and profitability is the primary objective. For commercial producers, the slight cost savings offered by GTM do not outweigh the potential losses in growth performance and feed efficiency.

Future economic analyses could explore the feasibility of GTM in different production settings, such as integrated farming systems where GTM could be produced on-site, further reducing costs. Additionally, exploring market opportunities for niche pork products, where the use of alternative feeds like GTM could be marketed as a value-added feature, might enhance the economic viability of GTM-based diets.

Conclusions

The study concludes that while Giant Taro Meal (GTM) can be used as a partial substitute for commercial feeds in hog diets, its use leads to reduced feed conversion efficiency and lower economic returns. Despite these drawbacks, the sensory evaluation of pork quality showed no significant differences, indicating that GTM does not detrimentally affect meat quality. However, the economic analysis suggests that the use of GTM may not be commercially viable at higher inclusion levels due to the associated decrease in growth performance and feed efficiency.

Future research should focus on optimizing the processing methods for GTM to improve its nutritional value and reduce the impact of anti-nutritional factors. Additionally, studies should investigate the long-term effects of GTM on animal health and the potential for using other locally available feed resources in combination with GTM to improve overall feed efficiency and economic viability.

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Disclosure: Use of AI Tools

In compliance with Threshold's guidelines for the ethical use of artificial intelligence (AI) and automated tools in academic research, the authors disclose the use of OpenAI's ChatGPT for enhancing the quality and clarity of the manuscript. ChatGPT was utilized to assist in refining the language, structure, and formatting of the text, ensuring a high level of academic rigor and coherence. The authors confirm that all data analysis, critical interpretations, and conclusions presented in this manuscript were conducted independently by the research team. The AI tool was employed strictly for editorial assistance and did not influence the scientific content or ethical considerations of the study. All intellectual contributions from the AI tool are in accordance with the authors' original intentions and have been reviewed and approved by all co-authors. The use of ChatGPT complies with Threshold's ethical standards and guidelines for transparent reporting of AI involvement in research. The authors remain fully responsible for the integrity and accuracy of the content presented in this paper.

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