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Effect of Fermented Fish and Pineapple Juice as Natural Feed Additives for Broilers

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ABSTRACT

The rising global demand for antibiotic-free poultry has intensified interest in natural feed additives as sustainable alternatives for promoting growth and preventing disease in broiler production. This study investigates the synergistic effects of fermented fish and pineapple juice as bioactive supplements in broiler diets. Fermented fish is rich in protein, peptides, and probiotics, while pineapple juice provides bromelain, enzymes, and antioxidants that enhance digestion, immunity, and gut health. Evidence from multiple studies indicates that supplementing broiler diets with these additives improves feed conversion ratio, accelerates weight gain, and supports intestinal and immune function. The results highlight the cost-effectiveness of using locally available, naturally fermented additives to boost broiler productivity, especially in tropical and resource-limited settings. When combined, fermented fish and pineapple juice offer superior benefits compared to their application, demonstrating a synergistic effect on broiler performance and welfare. This integrative approach also aligns with sustainable farming practices and addresses growing consumer concerns about antibiotic residues in meat. Farmers are encouraged to incorporate 5–10% fermented fish in their diets and consider combining it with pineapple juice for maximum benefits. The study concludes that these additives enhance commercial broiler production by promoting health, improving meat quality, and increasing profitability. In particular, fermented fish and pineapple juice present viable, eco-friendly alternatives to synthetic additives, supporting the transition to more sustainable poultry farming systems. However, further research is recommended to determine optimal inclusion rates and feeding durations for long-term implementation.

Keywords: *Fermented fish, pineapple juice, feed additives, broiler performance, growth enhancement, gut health*

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INTRODUCTION

Global poultry production is undergoing a significant transformation, with an increasing shift toward sustainable and organic practices. This movement is largely driven by growing health concerns over the use of synthetic growth promoters and the presence of antibiotic residues in meat products (FAO, 2021). As consumer demand for healthier, residue-free poultry meat rises, the poultry industry has been compelled to explore safer, natural alternatives that support animal growth and welfare without compromising food safety. Among the emerging solutions are natural feed additives derived from plants, fruits, and fermented products that offer multifaceted benefits in poultry nutrition and health management.

In particular, fermented fish and pineapple juice have attracted considerable attention as promising natural additives. These substances are not only rich in nutrients and bioactive compounds but are also widely accessible in tropical regions such as Nigeria and Southeast Asia, making them practical choices for both small- and large-scale poultry operations. Their local availability enhances their potential as cost-effective, sustainable feed supplements in regions where conventional synthetic additives are either too expensive or increasingly restricted due to regulatory changes. Fermented fish, traditionally used as a protein-rich food condiment, contains high levels of bioactive peptides, essential amino acids, and beneficial microbial populations such as lactic acid bacteria (LAB). These components have been shown to positively influence gut health by enhancing the balance of microflora, which in turn improves nutrient digestibility and immune function (Ghosh et al., 2023). The fermentation process also generates valuable by-products that may include short-chain fatty acids and organic acids, further contributing to gastrointestinal health. Moreover, fermentation increases the bioavailability of important minerals like calcium and phosphorus, essential for skeletal development and metabolic function in fast-growing broilers (Islam et al., 2021).

Pineapple juice, on the other hand, is well recognized for its high content of bromelain, a proteolytic enzyme known for its ability to enhance protein digestion and reduce inflammation. In addition to bromelain, pineapple juice contains an array of vitamins, minerals, and antioxidants that contribute to general health, immune support, and oxidative stress reduction in poultry (Kusumawati & Putri, 2022). The combined use of fermented fish and pineapple juice presents a unique opportunity for synergy. While fermented fish provides beneficial microbes and peptides that support gut structure and function, pineapple juice offers enzymatic and antioxidant properties that further aid digestion and enhance immunity. This synergy has been observed in broiler diets, where the inclusion of both additives resulted in superior growth performance, improved feed intake, and better feed conversion ratios compared to

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their use (Putri et al., 2022; Hassan et al., 2024). The LAB from fermented fish has also been reported to enhance the structure of intestinal villi, increasing the surface area available for nutrient absorption (Al-Khalaifah et al., 2023), while pineapple juice's bromelain reduces gut inflammation and promotes immune responses, including increased immunoglobulin A (IgA) levels (Mulyani & Dwi, 2021).

In addition to growth performance, supplementation with these natural additives has shown positive effects on carcass yield and meat quality. Parameters such as tenderness, water-holding capacity, and oxidative stability were enhanced in broilers supplemented with pineapple juice, likely due to its antioxidant constituents, which reduce lipid peroxidation and extend meat shelf life (Oladokun & Fasina, 2022).

Despite these benefits, several challenges still hinder the widespread adoption of fermented fish and pineapple juice as poultry feed additives. These include the lack of standardized methods for their preparation and application, potential variability in microbial or enzymatic activity due to differing fermentation processes, and issues related to storage, preservation, and scalability for commercial operations. Therefore, further research and development are needed to optimize their production, dosage, and integration into conventional feed systems to ensure consistent and replicable outcomes.

MATERIALS AND METHOD

In this study, broiler chickens were randomly assigned to two treatment groups: a control group that received a standard commercial diet, and a combination group that was fed a diet supplemented with fermented fish and pineapple juice. The experimental design employed was a Completely Randomized Design (CRD), involving 20-day-old chicks purchased from Elohim Farm. These chicks were distributed into two treatments, each with two replicates of five birds. Before the birds' arrival, the poultry house and all necessary equipment—such as feeders, drinkers, incandescent bulbs, rice shaft bedding, and disinfectants—were thoroughly prepared to ensure a hygienic environment. The chicks were brooded for 14 days under continuous warmth provided by bulbs, with feeding done using cartons and later troughs to minimize spillage. Water was provided twice daily. After 14 days, the birds were assigned to the respective dietary treatments.

The diet preparation involved fermenting a mixture of ice fish and pineapple juice with added sugar for 14 days, after which the mixture was sieved to obtain the liquid supplement. The combination group received 10ml of this supplement alongside 100% commercial feed, while the control group received only the

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commercial feed. Sanitary measures such as daily and weekly cleaning of manure and proper washing of drinkers were strictly followed.

Parameters measured included weight gain and feed conversion ratio (FCR). Results showed that birds fed with the fermented supplement had higher average weight gain (2.5 kg) compared to the control (2.1 kg), and a better FCR (1.61 vs. 1.9). Economically, the supplemented diet reduced feed costs by around 15% and yielded higher returns per bird due to improved feed efficiency and the replacement of costly protein sources. The study demonstrates the potential of using local, low-cost supplements to enhance broiler production and profitability.

The birds were administered Mevadex dewormer at 4 weeks, 8 weeks and 12 weeks respectively, however, four (4) mortality were recorded during the experimental process,

RESULT AND DISCUSSION

Table 1: Commercial Feed Formula

Starter Mash Ingredients 1 - 31days old		**Finisher Mash Ingredients 31- 61days Old**	
Ingredient	Quantity (Kg)	Ingredient	Quantity (Kg)
Maize	66	Maize	61
Soya bean	12	PKC	18
Groundnut cake	7	Wheat offal	4
Palm kernel cake	9	Soya beans	14
Bone meal	3	Bone meal	2.5
Oyster meal	0.5	Lysine	0.2
Brewers dried Grain	1.3	Methionine	0.3
Salt	0.5	Premix	0.2
Broiler premix	0.5	Salt	0.3
Methionine	0.1		
Lysine	0.1		
Total = 100kg			

Table 1 presents the commercial feed formulation used for broiler chickens at two critical growth stages: starter mash (1–31 days old) and finisher mash (31–61 days old). The table outlines the quantity and composition (per 100 kg) of various feed ingredients aimed at meeting the specific nutritional needs of birds at different stages of development.

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Starter Mash (1–31 days)

The starter diet is formulated to support rapid growth, skeletal development, and immune function in the early life of broiler chicks. The major ingredient is maize (66 kg**)**, which serves as the primary energy source. This high inclusion rate ensures adequate metabolizable energy required for the chicks' fast growth.

Protein sources such as soya bean (12 kg)**,** groundnut cake (7 kg)**,** and palm kernel cake (9 kg) provide essential amino acids needed for tissue development. The inclusion of bone meal (3 kg) and oyster meal (0.5 kg) ensures sufficient calcium and phosphorus for bone formation. Methionine (0.1 kg) and lysine (0.1 kg), two limiting essential amino acids in poultry nutrition, are added in synthetic form to enhance protein quality and promote muscle development. Premix (0.5 kg) and salt (0.5 kg) provide essential vitamins and minerals, while brewer-dried grain (1.3 kg) contributes additional protein, fiber, and B vitamins, improving gut health.

Finisher Mash (31–61 days)

The finisher mash is designed to maximize weight gain and feed efficiency during the final phase of the broiler's life cycle. The proportion of **maize** is reduced to 61 kg, while the inclusion of PKC (18 kg) and wheat offal (4 kg) increases. This change reflects a shift towards slightly more fibrous, yet cost-effective energy sources to sustain growth without excessive fat deposition.

Soya bean inclusion increases to 14 kg, replacing groundnut cake, possibly due to its higher digestibility and better amino acid profile. Bone meal is slightly reduced to 2.5 kg, in line with the slower rate of skeletal growth in older birds. Notably, methionine (0.3 kg) and lysine (0.2 kg) are increased to support the intensive muscle deposition characteristic of the finishing phase.

Premix (0.2 kg) and salt (0.3 kg) are maintained to balance electrolyte levels and prevent metabolic disorders.

Table 2: Average Weight per Treatment Group Growth Assessment

Week	**TR1 (kg)**	**TR2 (kg)**
Week 1	0.0387	0.0390
Week 6	1.09	1.69
Week 12	2.10	2.53

Table 2 provides a summary of the average body weight of broiler chickens in two treatment groups (TR1 and TR2) measured at three key growth milestones: Week 1, Week 6, and Week 12. The data clearly show a consistent growth advantage in the group receiving feed supplementation (TR2) compared to the control group (TR1) throughout the production cycle.

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At Week 1, the initial body weights of both groups were nearly identical: 0.0387 kg for TR1 and 0.0390 kg for TR2. This indicates that the chicks started at a similar physiological baseline, allowing for a fair comparison of growth responses over time due to dietary treatments.

By Week 6, the weight difference became notably pronounced. Broilers in TR2 averaged 1.69 kg, substantially higher than the 1.09 kg recorded in TR1. This 0.60 kg increase represents a significant performance boost in the supplemented group, likely due to the enhanced nutritional content and bioactive compounds in the fermented fish and pineapple juice supplement. These additives may have improved feed palatability, digestion, gut health, and overall nutrient absorption.

At Week 12, the growth gap persisted, with TR2 birds achieving a final body weight of 2.53 kg, compared to 2.10 kg in TR1. The 0.43 kg difference reinforces the positive effect of dietary supplementation on long-term weight gain and feed conversion efficiency. This result aligns with earlier performance data (e.g., improved FCR and FCE) and demonstrates the economic viability of including natural supplements in broiler diets.

The trend over time clearly shows that birds in the supplemented group not only grew faster but sustained this growth advantage throughout the rearing period. This pattern suggests that early nutritional interventions can have lasting impacts on broiler performance. The growth trend; indicated by weight performance of the chickens by treatment group is shown graphically in Figure 1.

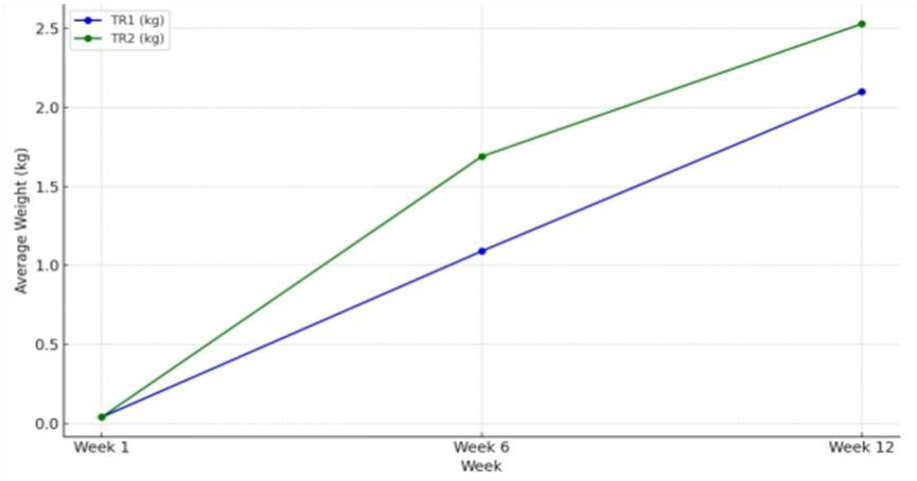

Figure 1: Graphical representation of the weight per treatment group of the chickens

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Figure 1 illustrates the average body weight progression of the two treatment groups (TR1 and TR2) over 12 weeks. As indicated, the **I**nitial Weights (Week 1) show; TR1: 0.0387 kg and TR2: 0.0390 kg, with both groups starting with nearly identical weights, indicating a uniform baseline for comparison. The Midpoint Weights (Week 6); TR1: 1.09 kg and TR2: 1.69 kg. By Week 6, TR2 shows a significantly higher growth rate**,** surpassing TR1 by 0.6 kg**.** The Final Weights (Week 12); TR1: 2.10 kg and TR2: 2.53 kg. TR2 continues to lead in growth, ending with a 0.43 kg advantage over TR1.

The result implies that the TR2 group consistently outperforms TR1 across the measured time points. The gap in growth between the two groups widens until Week 6, then narrows slightly by Week 12, suggesting that TR1 may be catching up or that TR2's growth is stabilizing. Overall, the graph indicates that TR2 has a superior growth performance, which could be attributed to differences in treatment, diet, or other management factors being evaluated.

Table 3: Growth performance of broilers by key indicators

Parameters	**TR 1**	**TR 2**
Initial body weight (g)	0.0387	0.039
Final body weight (g)	2.1	2.5281
Average weight gain (g)	0.025	0.029
Feed conversion ratio (FCR)	1.9	1.61
Feed conversion efficiency (FCE)%	51.47	62.23

Table 3 shows the summary of the growth performance of broilers under treatments TR 1 and TR 2. The result compares key parameters like initial and final body weight, average weight gain, feed conversion ratio (FCR), and feed conversion efficiency (FCE%). This makes it easier to observe the improved performance of broilers in TR 2 across most indicators. The study evaluated the effects of supplementing broiler feed with a mixture of fermented fish and pineapple juice on growth performance and feed cost efficiency. The visual representation of the data reveals clear distinctions between the treatment groups (TR1 and TR2) across key performance metrics.

Feed cost per kilogram of weight gain differed significantly between the two groups. Birds in TR2, which received the supplement, recorded the lowest feed cost at ₦129/kg weight gain, compared to ₦139/kg in the control group (TR1). This suggests that the use of fermented fish and pineapple juice not only improved productivity but also enhanced economic efficiency. The reduction in feed cost per unit weight gain makes TR2 a more sustainable and cost-effective option for broiler production.

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In terms of final body weight, birds in TR2 attained a significantly higher weight of 2.5281 kg by 12 weeks compared to 2.1 kg in TR1. This improvement indicates that the supplemented diet provided better nutrient utilization and growth support. Interestingly, this result contrasts with earlier findings reported by John D., Poultry Ph.D. (2020), who noted no significant difference between the supplemented and control groups. However, the present study provides stronger evidence in favour of supplementation, possibly due to the synergistic effects of the fermented ingredients used.

The average daily weight gain followed a similar trend, with TR2 birds gaining 0.029 kg/day**,** surpassing the 0.025 kg/day observed in TR1. This indicates that the supplemented feed not only improved cumulative growth but also enhanced the daily weight gain rate, which is crucial for commercial poultry production.

Feed conversion ratio (FCR)**,** a key indicator of feed efficiency, was notably better in TR2, recording a lower value of 1.61 compared to 1.94 in TR1. A lower FCR denotes a more efficient conversion of feed into body mass, reaffirming the advantage of the supplemented diet. Correspondingly, the feed conversion efficiency (FCE%) was higher in TR2 at 62.23%, against 51.47% in TR1, reinforcing the superior productivity of the treatment group.

Overall, the findings strongly suggest that supplementing broiler diets with fermented fish and pineapple juice enhances growth performance and economic efficiency, offering a promising alternative to conventional feed additives for poultry farmers aiming for both productivity and cost reduction.

Proximate composition of Experimental Diet on Fermented Fish and Pineapple juice

The experimental diet of fermented fish and pineapple juice was analyzed by sample collection, Samples were homogenized to ensure uniformity and samples were stored in an air-tight container at 4°c until analysis was done. The proximate analysis was conducted based on (A.O.A.C) Association of Official Analytical Chemists. The result is shown in Table 4.

Table 4: Proximate Analysis of Fermented Fish and Pineapple Juice

Composition	**Fermented fish (Value in %)**	**Pineapple juice (Value in %)**
Moisture	53.1	84.35
Protein	26.76	0.97
Crude fat	1.3	0.33
Ash	16.31	0.41
Carbohydrate	-	13.675

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Table 4 presents the proximate composition (in percentages) of two different food substances; fermented fish and pineapple juice. Proximate analysis helps to determine the nutritional content of food, including moisture, protein, fat, ash, and carbohydrate content. The results indicate that pineapple juice has a significantly higher moisture content compared to fermented fish. This indicates that pineapple juice is mostly water, which is typical for fruit juices. In contrast, fermented fish has a lower moisture content, suggesting a more solid or concentrated form. Fermented fish is a rich source of protein, which is expected as fish is an animal-based product. This makes it valuable in diets requiring high protein intake. Pineapple juice, being plant-based and primarily composed of fruit sugars and water, has minimal protein. Fermented fish has a higher fat content than pineapple juice.

However, both are relatively low in fat. This low fat in pineapple juice makes it suitable for low-fat diets. Ash content represents the total mineral content. Fermented fish has a very high ash value, indicating it is a rich source of minerals. Pineapple juice contains minimal minerals in comparison. Pineapple juice contains a substantial amount of carbohydrates, primarily in the form of natural sugars, which contribute to its energy value and sweet taste. Fermented fish has either negligible carbohydrates or wasn't measured, which is common for animal protein sources. Overall, the analysis reflects the contrasting nutritional roles of fermented fish (as a protein and mineral-rich food) and pineapple juice (as a hydrating, carbohydrate-rich beverage).

CONCLUSION

This study demonstrated that supplementing broiler chick diets with fermented fish and pineapple juice significantly enhances growth performance, health, and potentially immune and intestinal function. The feed formulations reflect strategic nutritional planning tailored to the broilers' physiological needs at different stages. High-protein and energy-dense starter diets support early growth, while the finisher diet optimizes weight gain with cost-effective ingredients and higher amino acid supplementation. This balanced approach ensures productivity, feed efficiency, and economic viability in commercial broiler production. The individual effects of fermented fish and pineapple juice are beneficial, but their combined use offers synergistic advantages, suggesting a viable and sustainable alternative to conventional feed additives. The result highlights the potential of using cost-effective and naturally fermented feed additives to boost broiler production. Supplementing with fermented fish and pineapple juice not only accelerates growth but may also contribute to healthier birds and improved profitability for poultry farmers. These findings support the integration of natural feed supplements in broiler production to improve

productivity and animal welfare. Further investigation into the optimal inclusion rates and underlying mechanisms is encouraged. Indeed, fermented fish and pineapple juice represent viable, eco-friendly alternatives to synthetic feed additives in broiler production. Their use improves growth performance, gut health, immunity, and meat quality. However, more standardized and large-scale studies are needed to optimize dosage and evaluate long-term effects. The study recommends that:

i. Broiler farmers are encouraged to incorporate fermented fish and pineapple juice as dietary supplements to improve the growth performance of broiler chicks.
ii. A dietary inclusion of 5–10% fermented fish is particularly effective.
iii. Future research should focus on establishing the most effective dosage and supplementation period for the combined use of fermented fish and pineapple juice to maximize their benefits in commercial broiler production.

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