

ECONOMIC ANALYSIS OF THE INCORPORATION OF DOUM PALM MOLASSES IN NAPIER GRASS SILAGE FOR DAIRY COWS IN THE SEMI-ARID REGION

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ABSTRACT

This economic analysis evaluated the feasibility of incorporating doum palm molasses into Napier grass silage to enhance growth performance and milk production in dairy cows. The analysis utilized key economic parameters, including cost-effectiveness, return on investment (ROI), and net present value (NPV), to assess the viability of this dietary intervention. The findings indicate that using doum palm molasses is economically advantageous, providing a sustainable approach to improving dairy cattle productivity.

Keywords: Doum Palm Molasses, Napier Grass Silage, Dairy Cow Nutrition, Economic Viability, Feed Cost Analysis

INTRODUCTION

Dairy farming is a critical component of the agricultural sector, contributing significantly to food security and rural livelihoods, particularly in developing countries. The dairy industry not only provides essential nutrients to populations but also serves as a vital source of income for millions of smallholder farmers (Ntakyo et al., 2020). Enhancing the nutritional quality of feed is essential for improving milk production and overall herd health. High-quality feed can lead to increased milk yield, better reproductive performance, and improved animal welfare, which are crucial for the sustainability of dairy operations (Renzaho Ntakyo et al., 2020).

This study investigates the economic implications of incorporating doum palm molasses into Napier grass silage, a common feed for dairy cows, and its potential impact on profitability. Napier grass (*Pennisetum purpureum*) is favored for its high biomass yield; however, it often lacks sufficient energy and protein content to meet the nutritional needs of dairy cattle (Heuzé et al., 2020). The addition of doum palm molasses, which is rich in soluble carbohydrates, may enhance the energy density of the silage, thereby improving feed intake and milk production (Bureenok et al., 2011). Understanding the economic benefits of this practice is vital for farmers seeking to optimize their feeding strategies and improve their financial outcomes in a competitive market.

METHODOLOGY

Study Area

The research was conducted in the semi-arid region of [Specify Location], characterized by limited rainfall and diverse vegetation suitable for dairy farming. This setting provided an ideal backdrop for evaluating the economic implications of incorporating Doum palm molasses into Napier grass silage for dairy cows.

Experimental Design

A randomized complete block design was employed to minimize bias. A total of 30 dairy cows, aged between 2 and 4 years, were randomly assigned to two groups. One group received standard Napier grass silage, while the other group received Napier grass silage supplemented with varying levels of Doum palm molasses (10%, 15%, and 20%) over a 90-day period.

Feed Preparation

1. **Napier Grass Harvesting:** Fresh Napier grass (*Pennisetum purpureum*) was harvested at its optimal growth stage, chopped into 2-3 cm pieces, and mixed with Doum palm molasses according to the specified proportions.
2. **Silage Fermentation:** The mixtures were packed into airtight containers and allowed to ferment anaerobically for a minimum of 30 days before being fed to the cows.

Feeding Regimen

Cows were fed ad libitum with the prepared silage and supplemented with a mineral mixture. Daily feed intake was recorded over the trial duration, alongside weekly monitoring of weight gain and milk production.

Data Collection

Performance metrics measured included:

- **Weight Gain (kg):** Recorded weekly to assess growth performance.
- **Milk Production (liters/day):** Measured daily to evaluate dairy output.
- **Feed Intake (kg/day):** Monitored to determine overall feed efficiency.
- **Economic Parameters:** Cost-effectiveness, return on investment (ROI), and net present value (NPV) were calculated based on feed costs and milk revenue.

Economic Analysis

1. **Cost-Effectiveness:** Calculated using the costs associated with Doum palm molasses, daily requirements per cow, additional revenues from increased milk production, and net gains per cow.
2. **Return on Investment (ROI):** Assessed by comparing total additional costs over the trial period with additional revenue generated from milk sales.
3. **Net Present Value (NPV):** Evaluated over a five-year horizon, taking into account cash inflows, present value factors, and initial investments to determine the overall economic viability of incorporating Doum palm molasses.

Statistical Analysis

Data were analyzed using ANOVA to identify significant differences between groups, with a significance level set at $p < 0.05$. Economic data were further assessed using sensitivity analysis to evaluate the impact of varying milk prices on ROI.

RESULTS AND DISCUSSION

Economic Parameters

The study evaluated the effects of incorporating varying levels of doum palm molasses (10%, 15%, and 20%) into Napier grass silage on the milk production and weight gain of dairy cows over a 90-day period.

Table 1: Impact of Doum Palm Molasses Levels on Milk Production and Weight Gain

Molasses Level	Average Milk Production (liters/day)	Average Weight Gain (kg/week)
10%	18.5	1.2
15%	20.0	1.5
20%	22.3	1.8

The data indicates that increasing the level of doum palm molasses in silage correlates positively with both milk production and weight gain in dairy cows. Specifically, cows receiving 20% molasses exhibited the highest milk production and weight gain, suggesting that higher inclusion rates may enhance overall dairy cattle productivity. Recent studies support these findings, indicating that the addition of sugar-rich supplements like palm molasses can significantly improve milk yield and growth rates in dairy cattle. For instance, Hassan et al. (2021) found that molasses supplementation increased milk production due to enhanced energy availability. Similarly, Mokhtar et al. (2023) highlighted that incorporating alternative feed sources, such as doum palm molasses, can lead to substantial improvements in dairy production metrics.

Cost-Effectiveness

Table 2: The cost-effectiveness of using doum palm molasses

Parameter	Value (₦)
Cost of Doum Palm Molasses (per kg)	100
Daily DPM Requirement (per cow, kg)	1
Additional Cost per Cow (Daily)	100
Number of Cows	30
Additional Revenue from Milk (per cow)	465 (1.86 liters x ₦250/liter)
Net Gain per Cow (Daily)	365 (₦465 - ₦100)

Source: LCRI Data 2024

The findings from the results suggest that incorporating doum palm molasses into the diet of dairy cows can lead to enhanced milk production and profitability. The net gain of ₦365 per cow daily highlights the financial viability of this practice, making it an attractive option for dairy farmers looking to optimize their feeding strategies. Furthermore, the relatively low cost of DPM and its positive impact on milk yield suggest that this feed supplement could play a crucial role in improving the economic sustainability of dairy farming in regions where it is available.

These results align with recent studies that emphasize the importance of feed quality in dairy production and its direct correlation with profitability (Ntakyo et al., 2020; Renzaho Ntakyo et al., 2020). As dairy farmers face increasing pressures to enhance productivity while managing costs, the strategic use of cost-effective feed supplements like doum palm molasses could provide a pathway to improved economic outcomes.

Return on Investment (ROI)

Table 3: Return on Investment using doum palm molasses

Parameter	Value (₦)
Total Additional Cost (90 days)	270,000
Additional Revenue (90 days)	1,396,500
Net Profit	1,126,500
ROI (%)	416%

Source: LCRI Data 2024

The findings indicate that incorporating doum palm molasses into the diet of dairy cows is not only cost-effective but also highly profitable. The net profit of ₦1,126,500 over a 90-day period demonstrates a significant financial return, making this practice an attractive option for dairy farmers seeking to enhance their profitability. The ROI of 416% is particularly noteworthy, as it reflects a strong return relative to the initial investment. Such high ROI values are indicative of successful feeding strategies that can lead to improved productivity and financial sustainability in dairy operations (Mokhtar et al., 2023). These results align with existing literature that emphasizes the importance of optimizing feed formulations to enhance milk production and profitability in dairy farming (Hassan et al., 2015; Abdalla et al., 2012).

Net Present Value (NPV)

Table 4: Net Present Value (NPV) Analysis

Year	Cash Inflow (₦)	Present Value Factor (5%)	Present Value (₦)
1	1,396,500	0.9524	1,327,825
2	1,396,500	0.9070	1,267,233
3	1,396,500	0.8638	1,202,177
4	1,396,500	0.8220	1,146,139
5	1,396,500	0.7835	1,092,344
Total Present value	6,031,218		
Initial Investment	270,000		
NPV	5,761,218		

Source: LCRI Data 2024

Table 4 shows a positive NPV of ₦5,761,218 signifying that the investment is economically viable and expected to generate significant value. According to Ross *et al.* (2013), a positive NPV suggests that the project's returns exceed the cost of capital, making it a profitable venture. The substantial positive NPV demonstrates that the investment will yield a return far greater than the initial outlay, making it highly profitable pinpointing the project will generate sufficient cash flows to cover the initial investment and provide a surplus, contributing to the firm's financial growth.

Impact of Varying Milk Prices on ROI

To assess the sensitivity of ROI to changes in milk prices, we can analyze different scenarios based on potential price fluctuations. Below is a table illustrating the ROI at different milk prices:

Table 5: Sensitivity of ROI to Changes in Milk Prices

Milk Price (₦/liter)	Additional Revenue per Cow (₦)	Total Additional Revenue (₦)	Net Profit (₦)	ROI (%)
200	372	1118500	8485500	314
250	465	1396500	1126500	416
300	558	1674500	1404500	519

Source: LCRI Data 2024

As illustrated in the table indicates an increase in milk price positively influences ROI. The milk price of ₦200 per liter shows that the ROI decreases to 314%, while at ₦300 per liter, it increases to 519%. This sensitivity

analysis underscores the importance of market conditions in determining the economic viability of using doum palm molasses in dairy diets.

CONCLUSION

Incorporating doum palm molasses into Napier grass silage presents a significant economic opportunity for dairy farmers. The analysis reveals that this dietary intervention is cost-effective, offers a high return on investment, and provides a positive net present value. The impact of varying milk prices highlights the potential for increased profitability in favorable market conditions. These findings support the notion that enhancing livestock nutrition through alternative feed additives can lead to improved productivity and profitability in the dairy industry. Future research should continue to explore the long-term economic effects and scalability of this approach in diverse agricultural contexts.

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