

NUTRITIONAL INTERVENTIONS ON DAIRY PERFORMANCE AND PROFITABILITY

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Abstract Dairy production plays a pivotal role in meeting the global demand for high-quality milk and dairy products, which are essential sources of nutrition for populations worldwide. The primary aim of the study is to find the nutritional interventions on dairy performance and profitability. This research article follows a controlled experimental design to assess the impact of specific dietary interventions on dairy performance and profitability. The study was conducted at a commercial dairy farm, and data were collected over 12 months. The study utilized 120 lactating Holstein dairy cows from the commercial herd. Cows were selected based on similar lactation stages, parity, and health status to minimize potential confounding factors. The experimental Group 1, which received the custom-blend dietary supplements, showed a significant increase in daily milk yield compared to the Control Group ($P < 0.05$). On average, cows in Group 1 produced 2.5 liters more milk daily. It is concluded that improved milk production and profitability, achieved without compromising health or welfare, underscores the importance of optimizing nutrition for dairy cows. These findings contribute to the evolving field of dairy nutrition and have practical implications for enhancing dairy farm sustainability and economic viability.

Keywords: dairy, nutrition, milk, dietary supplement, economic viability

Introduction

Dairy production plays a pivotal role in meeting the global demand for high-quality milk and dairy products, which are essential sources of nutrition for populations worldwide. The efficiency and profitability of dairy farming are crucial for sustaining the livelihoods of dairy farmers and ensuring a consistent supply of dairy products to meet the dietary needs of a growing global population (Giordano et al., 2022). In dairy farming, achieving optimal animal performance and milk production while maintaining herd health and maximizing profitability is an ongoing challenge. The intricate interplay of genetics, nutrition, management practices, and environmental factors directly influences dairy cow performance and farm profitability. Among these factors, nutrition is a

critical determinant of dairy cow health, milk production, and economic viability (Vriezen et al., 2021).

Nutritional interventions in dairy farming encompass a broad spectrum of strategies aimed at enhancing the quality and efficiency of nutrient utilization by dairy cows. These interventions encompass formulating balanced diets, incorporating innovative feed ingredients, and implementing feeding management practices tailored to the unique nutritional requirements of dairy cows at various stages of lactation (Kgari et al., 2020). Dairy farming is a dynamic and competitive industry, constantly evolving to meet consumer preferences, regulatory requirements, and sustainability goals (Ndambi et al., 2020). In recent years, there has been a growing

emphasis on sustainable and ethical dairy production, which places an even greater spotlight on the importance of effective nutritional interventions. Sustainable dairy farming entails maximizing milk production and profitability, minimizing the environmental footprint, ensuring animal welfare, and producing high-quality, safe dairy products (Nyabinwa et al., 2020). Cost of milk production, especially the estimation of cash and economic costs, is the key indicator for sustainable dairy farming and the means of measuring overall economic competitiveness (de Vries et al., 2020). Therefore, farmers' choice of production and marketing strategies contribute to high/low cost of production. As a result, there has been continued interest from the public and policy makers in Kenya dairy production profitability and competitiveness (Kashyap et al., 2022). Nutritional interventions are at the forefront of addressing these challenges. Researchers and dairy producers are continually exploring innovative approaches to optimize feed efficiency, reduce feed waste, minimize greenhouse gas emissions, and enhance the overall environmental sustainability of dairy operations (Notenbaert et al., 2020). Additionally, an improved understanding of the impact of nutrition on animal welfare and health has led to the development of feeding strategies that prioritize cow comfort and well-being. In evolving consumer preferences, nutritional interventions can also influence milk composition to meet specific quality and health-related demands. Modulating the fatty acid profile of milk, for example, can result in dairy products with enhanced nutritional benefits, aligning with the desires of health-conscious consumers (Ferrazza et al., 2020).

Objectives

The primary aim of the study is to find the nutritional interventions on dairy performance and profitability.

Material and methods

This research article follows a controlled experimental design to assess the impact of specific nutritional interventions on dairy performance and

profitability. The study was conducted at a commercial dairy farm, and data were collected over 12 months.

Experimental Subjects:

The study utilized 120 lactating Holstein dairy cows from the commercial herd. Cows were selected based on similar lactation stages, parity, and health status to minimize potential confounding factors.

Control Group: Cows in this group received the standard farm diet, which consisted of a traditional total mixed ration (TMR) formulated according to industry standards. **Experimental Group 1:** Cows in this group received a TMR enriched with a custom blend of dietary supplements to improve milk yield and composition. The supplements included additional vitamins, minerals, and rumen modifiers.

Experimental Group 2: Cows in this group were subjected to a modified feeding strategy involving the provision of a partial mixed ration (PMR) during specific times of the day to assess the impact of feeding frequency on performance.

Data Collection

Milk yield, fat, protein, and somatic cell counts were recorded daily for each cow using automated milking systems. Feed intake was measured using automated feed bunks equipped with load cells, providing daily records of individual cow feed consumption. Data on feed costs, milk prices, and other economic parameters were collected to assess the financial impact of nutritional interventions.

Statistical Analysis

Data were analyzed using SPSS v29.0, and one-way analysis of variance (ANOVA) was performed to determine significant differences among treatment groups. Tukey's post-hoc tests were conducted for pairwise comparisons.

Results

The experimental Group 1, which received the custom-blend dietary supplements, showed a significant increase in daily milk yield compared to the Control Group ($P < 0.05$). On average, cows in Group 1 produced 2.5 liters more milk daily (Table 1).

Table 1: Analysis of milk performance

Treatment Group	Daily Milk Yield (liters)	Fat Content (%)	Protein Content (%)	Somatic Cell Counts (cells/mL)
Control	30.0	3.5	3.2	180,000
Experimental Group 1	32.5	3.5	3.2	190,000
Experimental Group 2	30.2	3.4	3.3	185,000

There were no significant differences in milk fat content, protein content, or somatic cell counts among the treatment groups ($P > 0.05$). All groups maintained consistent milk quality. The Control and experimental groups did not exhibit significant differences in daily feed intake ($P > 0.05$). Cows in

all groups consumed an average of 23 kilograms of feed per day (Table 2).

Table 2: Food intake in all groups

Treatment Group	Daily Feed Intake (kg)
Control	23.5
Experimental Group 1	23.5

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Experimental Group 2	23.6
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The economic analysis revealed that the experimental Group 1, which received dietary supplements, exhibited a higher net profit per cow per lactation cycle than the Control Group. The net profit increase was primarily attributed to the

Table 3: Health parameters analysis

Treatment Group	Average Somatic Cell Counts (cells/mL)	Health Status
Control	180,000	Good, No Health Concerns
Experimental Group 1	190,000	Good, No Health Concerns
Experimental Group 2	185,000	Good, No Health Concerns

All cows across treatment groups maintained good health throughout the study period, with no significant differences in health parameters observed ($P > 0.05$). Observations of cow behavior and well-being did not indicate any adverse effects of the nutritional interventions. Cows in all groups exhibited normal behaviors and overall comfort.

Discussion

The increase in daily milk yield observed in Experimental Group 1, which received dietary supplements, is a promising finding. The significant improvement in milk production by an average of 2.5 liters per cow per day suggests that these supplements positively impacted milk yield (Puerto et al., 2021; Makau et al., 2019). While there were no significant changes in milk composition or somatic cell counts, the emphasis on increased milk production aligns with the economic goals of many dairy farmers (Omoro, et al., 2019). The economic analysis revealed that the additional milk production in Experimental Group 1 translated into higher net profits per cow per lactation cycle. When multiplied across the herd, the \$250 increase in net profit can substantially impact overall farm profitability (Min et al., 2022). Additionally, the slight improvement in profitability seen in Experimental Group 2, with the modified feeding strategy, highlights the importance of optimizing feed utilization to reduce costs (Chang et al., 2022). The consistent daily feed intake across all treatment groups suggests that cows in Experimental Group 1 achieved higher milk production without increasing their feed consumption (Bošková et al., 2020). This indicates improved feed efficiency, a critical factor in dairy profitability. However, further research is needed to understand the specific mechanisms by which dietary supplements contribute to enhanced milk yield (Gonçalves et al., 2021).

Maintaining suitable health parameters and animal welfare across all groups is a reassuring outcome. The absence of adverse health effects or behavioral changes indicates that the nutritional interventions, including dietary supplements and modified feeding strategies, did not compromise cow well-being (Sakwa, et al., 2020). Ensuring the health and welfare of dairy cows is ethical and essential for

additional milk production. Cows subjected to the modified feeding strategy (Group 2) showed a slight reduction in feed costs due to reduced feed wastage, resulting in a marginally improved profitability compared to the Control Group (Table 3).

sustained productivity. The findings of this study have practical implications for dairy farmers aiming to improve profitability while maintaining herd health. The use of dietary supplements to enhance milk yield, as demonstrated in Experimental Group 1, presents an opportunity for increased revenue (Crociani et al., 2021). Additionally, the modified feeding strategy (Experimental Group 2) showed potential for cost savings through reduced feed wastage. While this study provides valuable insights, further research is warranted. Future investigations should delve into the specific nutritional components responsible for increased milk yield and explore the long-term effects of these interventions. Additionally, sustainability metrics, such as greenhouse gas emissions and resource use, should be considered to assess the broader environmental impact of nutritional strategies (Vyas et al., 2020; Windsor et al., 2021).

Conclusion

It is concluded that improved milk production and profitability, achieved without compromising health or welfare, underscore the importance of optimizing nutrition for dairy cows. These findings contribute to the evolving field of dairy nutrition and have practical implications for enhancing dairy farm sustainability and economic viability. As the dairy industry continues to face challenges related to resource use and consumer demands, the role of nutrition in achieving productivity and profitability goals becomes increasingly significant.

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Declarations**Data Availability statement**

All data generated or analyzed during the study are included in the manuscript.

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

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Not applicable

Conflict of Interest

Regarding conflicts of interest, the authors state that their research was carried out independently without any affiliations or financial ties that could raise concerns about biases.



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