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Feeding Balanced Ration for Improving Dairy Cattle Productivity: A Review

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

In India and similar subtropical regions, dairy livestock primarily consume various by-products derived from locally cultivated crops, fodder, and oilseeds. Approximately 65-70 per cent of the total milk production cost is attributed to feed expenses. Ensuring a balanced diet is pivotal for the success of dairy development initiatives across India. The optimal productivity of dairy animals is achieved when they are provided with a nutritionally balanced diet that matches their genetic potential. To enhance the productivity of livestock owned by small-scale farmers, a balanced ration program was introduced. Under this program, animals are categorized based on their milk production levels: low (<8 kg/day), medium (8–12 kg/day), and high (>12 kg/day) yielders. The program assessed milk yield, milk fat content, and the net daily income of milk producers before and after implementing a balanced diet regimen. The nutritional assessment revealed that 71 per cent of the animals consumed excessive amounts of crude protein and metabolizable energy, while 65 per cent exhibited lower intake levels of calcium and phosphorus than required. Implementing a balanced ration resulted in an improvement in milk production ranging from 2 to 14 per cent, along with a 0.2 to 0.15 per cent increase in milk fat content.

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1. INTRODUCTION

Approximately 70% of milk producers in India and other developing nations are small-scale or landless farmers, for whom the income generated from milk sales is crucial for their livelihood [1]. It is widely recognized that inadequate nutrition significantly affects the productivity and health of farm animals. Studies have revealed both deficiencies and excesses of protein and energy in field conditions, particularly in the informal sector (Mudgal et al., 2003). Meeting the growing demand for milk and meat presents a significant challenge, with projections indicating a substantial increase in global demand, especially in developing countries, by 2050 FAO, [2]. However, imbalanced feeding remains a primary factor contributing to lower productivity in many developing nations [1]. Addressing this issue is crucial to meet future demand.

Livestock products are essential components of diets in both rural and rapidly urbanizing areas. However, sustainability concerns arise due to the growing population and limited feed resources in tropical regions. Despite feed shortages, there is considerable potential to enhance production levels by addressing nutritional imbalances. Matching nutrient requirements with locally available feed resources is vital for improving the productivity of dairy animals in tropical regions [3]. This approach not only enhances production and nutrient use efficiency but also offers a promising strategy to mitigate methane emissions from ruminants.

While ration balancing is common practice in developed countries with abundant and high-quality feed resources, it is less prevalent in India and tropical regions. Here, smaller herd sizes and traditional feeding practices contribute to nutrient imbalances in terms of protein, energy, minerals, and vitamins. Therefore, this study aims to investigate the impact of nutrient balancing on the productivity and economics of milk production in dairy animals.

2. METHODOLOGY FOR LITERATURE REVIEW

The literature review methodology involved accessing existing and recent papers via various scholarly databases including Google Scholar, ResearchGate, EBSCO, Scopus, and Science Direct, among others. Relevant research and review articles published between 2010 and 2022 were thoroughly examined. While this review encompasses valuable insights from numerous significant studies, it does not aim to provide an exhaustive literature review. Instead, it presents inferences derived from the information gathered from the cited articles. Articles considered for inclusion were restricted to those written in the English language.

2.1 Balanced Ration

A balanced ration is meticulously formulated to provide animals with the requisite nutrients in precise proportions and quantities essential for their sustenance over a 24-hour period, supporting a myriad of physiological functions. It encompasses a blend of proteins, energy sources, minerals, and vitamins derived from dry and green fodder, concentrates, and mineral supplements, ensuring optimal performance and robust health. Achieving proper balance necessitates a thorough understanding of the chemical composition of available feedstuffs alongside the specific nutrient requirements of the animals Wu, G. [4].

Imbalanced feeding results in:

- ✓ The Lower milk production of animals than their genetic potential.
- ✓ Slow growth in young animals and delayed in age at first calving.
- ✓ Poor growth, low milk production and reproduction of dairy animals.
- ✓ Imbalanced feeding results in a short productive life.
- ✓ Animals are more prone to metabolic disorders such as milk fever and ketosis.
- ✓ Imbalanced feeding results in short lactation length and longer calving intervals.

2.2 Effect of Ration Balancing

In the tropical feeding system of India, achieving ration balance has resulted in a notable increase in daily income, primarily attributable to heightened daily milk yield and elevated milk fat levels. Additionally, there has been a reduction in medicinal charges alongside a decrease in feeding costs. Balanced ration implementation has notably enhanced feed conversion efficiency and microbial nitrogen synthesis in dairy animals. Furthermore, balanced feeding has played a pivotal role in bolstering immunity and mitigating incidences of parasitism among field animals.

2.3 Types of Rations

1. **Maintenance Ration:** The maintenance ration refers to the minimum quantity of feed required over a 24-hour period to sustain the animal's body and essential bodily functions without any gain or loss of body weight. In essence, it provides the necessary sustenance for an animal to maintain its basic metabolic needs when not engaged in work or production.
2. **Milk Production Ration:** The milk production ration comprises the additional amount of feed necessary over a 24-hour period to support milk production beyond the maintenance ration. The quantity of production ration required is contingent upon both the volume of milk produced and the percentage of fat content in the milk.
3. **Growth Ration:** A growth ration necessitates an additional 20 per cent of the maintenance ration if the animal is three years old or younger. For animals aged between three and four years, a 10 per cent extra allowance is required. However, for adult animals over four years of age, a maintenance diet suffices without any additional supplementation for growth.
4. **Gestation Ration:** The gestation ration refers to the supplementary feed required during the pregnancy period to facilitate proper foetal growth and maintain the mother's health for subsequent lactation. Additional allowances are typically provided to the animal during the last two months of pregnancy to support the increased nutritional demands associated with gestation.

2.4 Feeding Allowances

The recommended feeding allowance for dairy cattle includes providing 2 kg of compound cattle feed daily for milking animals, along with additional allowances based on milk production. Ensuring a well-balanced ration and monitoring feed intake and efficiency are essential for their health and productivity.

2.5 The Desirable Characteristics of a Ration

The ration should be properly balanced for animal requirements.
The ration must be palatable and easily digestible.
Provide a variety of feed in the ration.
The ration should contain enough mineral matter.
The ration should be fairly laxative and Bulky.
The ration should contain sufficient green fodder preferably legumes.
Avoid any sudden changes in the ration.
Properly maintain regularity in the ration of dairy animals.
The feed must be properly prepared and balanced.
A ration should not be too bulky.
The ration should be economic in labour and cost.

Fig. 1. The Effect of ration balancing on various parameters in dairy animal

Table 1. The Feeding allowances for dairy cattle and buffalo

Types of Animals	Stage of the Animals	Green fodder (kg/d/animal)	Dry fodder (kg/d/animal)	Concentrates (kg/d/animal)
Cow (Avg. Wt. 250 kg)	Milk yields 5 litres/day	15.0	5.0	2.0
	Milk yield 5-10 litres/day	17.5	5.5	3.0
	Milk yield 10-15 litres/day	20.0	6.0	4.0
Cow in gestation	-	15.0	5.0	1.5
Buffalo (Avg. Wt. 400 kg)	Milk yields 5 litres/day	15.0	5.0	2.5
	Milk yield 5-10 litres/day	20.0	6.0	4.0
	Milk yield more than 10 litres/d	25.0	7.0	5.0
Bull (Avg. Wt. 300 kg)	During days of Work	20.0	7.0	2.0
	During days of no work	15.0	5.5	1.0

Source: TNAU

2.6 Impact of Feeding Balanced Ration

1. Improved Milk Production and Income: Studies have shown that a balanced ration enhances milk production and increases the net daily income of dairy animals [1]. The cost of milk production can be significantly reduced, ranging from Rs. 0.25 to 2.00 per kg [5]. Additionally, the average daily milk yield per cow typically increases by 0.2 to 1.0 kg, with a concurrent rise in milk fat content by 0.2 to 0.6 per cent units [5]. Furthermore, a balanced ration often leads to an increase in the solid-not-fat (SNF) content of milk [5].
2. Genetic Potential and Lactation Stage Dependency: Animals with higher genetic potential are expected to respond better to balanced ration in terms of increased milk production [3]. The response to balanced ration also varies depending on the stage of lactation, with animals in early lactation showing more significant improvements compared to those in mid and late lactation [3].
3. Enhancement of Rumen Microbial Protein Synthesis: Balanced ration enhances rumen microbial protein synthesis in low to medium milk-yielding dairy animals [6,5]. This is crucial as microbial protein synthesis in the rumen plays a vital role in meeting the protein and energy requirements of the animals. Optimizing rumen fermentation maximizes dietary fiber digestion and microbial protein production.
4. Immune Function and Parasitic Load Reduction: Imbalanced diets can adversely affect enzyme activity and impair immune function [7]. Balanced ration provides essential minerals necessary for the functionality of structural proteins, enzymes, and cellular proteins, thus supporting overall immune function. Additionally, a balanced ration decreases parasitic load in animals, which positively impacts growth, milk production, and general health [7].
5. Methane Emission Reduction: Animals on imbalanced diets tend to produce more methane per litre of milk [8]. However, a balanced ration plays a crucial role in decreasing enteric methane emissions in dairy animals, contributing to environmental sustainability and mitigating greenhouse gas emissions [9].

2.7 Benefits of a Balanced Ration

- ✓ The balanced ration improves milk production and also improves milk quality (Fat and SNF).
- ✓ Balanced ration reduced daily feeding costs and increased daily income [10-12].
- ✓ Improvement in reproduction efficiency in dairy animals.

- ✓ Balanced ration reduces the parasitic load in dairy animals.
- ✓ A balanced ration gives a better immune response, and better resistance against diseases.
- ✓ Balanced ration feeding reduced methene emission and nitrogen excretion in dairy animals.
- ✓ The Reduction in calving interval, and as a result increase in productive life [13-15].
- ✓ Balanced ration improves the all-over growth rate of calves, leading to early maturity and earlier calving.
- ✓ Efficient utilisation of locally available feed resources [13-15].

3. CONCLUSIONS

In conclusion, the discussion highlights the prevalence of imbalanced feeding in the experimental area and underscores the significant benefits of balanced feeding in enhancing immunity, productivity, and profitability of dairy enterprises. Given that feeding alone constitutes over 70 per cent of the total cost of milk production, implementing balanced feeding programs for dairy animals can play a pivotal role in successful dairy development programs worldwide [16-18]. To maximize profitability, it is essential to ensure that animals receive the required quantities of protein, energy, minerals, and vitamins, preferably sourced from locally available feed resources.

Implementing balanced ration programs under small holding systems presents challenges, but large-scale implementation in tropical countries can lead to increased milk production, reduced methane emissions, nitrogen excretion into the environment, and lower feeding costs [19-21]. There is a pressing need to promote balanced feeding and ration reappropriation techniques among dairy farmers in field conditions to optimize animal health, productivity, and environmental sustainability [22-24].

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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