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# Multinutritional Blocks in Ruminants: A Strategic Look from Agribusiness through Meta-Analysis

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**Abstract**

The production of ruminants in grazing systems represents a key alternative to achieve sustainable food, since fodder is one of the most economical and natural sources for these animals. However, one of the most critical challenges in many regions of the world are recurring droughts, which limit the availability of grass and affect livestock productivity. Faced with this scenario, multinutritional blocks (BMN) arise as an accessible and effective solution, since they provide energy, protein and mineral supplementation during the dry season, improving the digestibility of fodder and animal performance. This study aimed to carry out a meta -analysis of scientific literature on BMN published since 2017, with emphasis on its use in cattle, sheep, goats, buffalos and other ruminant species, both for the production of meat and milk. Data collection was carried out through the Scopus and Google Scholar platforms, using inclusion criteria focused on scientific articles focused on the formulation and application of BMN, and excluding thesis, technical articles, interviews and non -scientific materials. The results suggest that, although there is evidence of the benefits of BMN, there is still a significant need for deeper research in this


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field. This technology represents a strategic tool to improve the profitability of the agricultural sector, especially in climate stress contexts.

**Keywords:** Multinutritional Blocks, Meta -Analysis, Ruminants, Grazing, Sustainability

## INTRODUCTION

Rumin -based livestock plays a fundamental role in global food security, offering high biological value proteins that are essential in the human diet. These animals have the extraordinary ability to transform fibrous fodder, low nutritional value for humans, into products of animal origin such as meat and milk. This efficient conversion represents a strategic advantage, particularly in tropical regions where natural grasslands constitute the main food source for cattle.

However, livestock production in these areas faces significant limitations due to the variable and seasonal quality of fodder. During the dry season, the availability of plant biomass decreases drastically, and the pastures that subsist usually have a low content of essential nutrients, especially raw protein and metabolizable energy. This nutritional imbalance directly affects the growth, reproduction and production of livestock, reducing the profitability of extensive production systems (Romero-Marcano et al., 2019).

Given this challenge, producers are in need of implementing supplementation strategies that allow covering the lack of fodder and sustaining animal performance. Traditionally, concentrated supplements have been an option, but its high cost and limited availability in many rural areas make it necessary to look for more economical and accessible alternatives. In this context, multinutritional blocks (BMN) have emerged as an innovative, efficient and viable solution.

According to Romero-Marcano et al. (2019), BMN are characterized by their simplicity of preparation and use. They are compact and solid products that concentrate a balanced mixture of nutrients, designed to complement the dietary deficiencies of cattle during critical times, such as the dry season. Unlike traditional concentrated foods, multinutritional blocks can be made locally from accessible raw materials, many of which come from agricultural or agroindustrial by -products. This characteristic makes them a sustainable and

low -cost alternative, with great potential to improve the productive efficiency of small and medium -scale livestock systems.

The common ingredients used in the formulation of the BMN include agricultural waste such as the corn stubble, cane bagasse, fruit shells and oleaginous seeds, as well as energy sources such as cane molasses. Although these materials naturally have low digestibility and little protein content, their integration into nutritionally balanced blocks allows to improve its use by the rumen, thanks to the stimulus of microbial activity and synergy between the different components of the diet (Borroto et al., 2018).

A key point in favor of BMN is their practical management in field conditions. Rodríguez-Molano & Pulido-Suárez (2018) highlight that, unlike liquid supplements or flour, the blocks are easy to store, transport and administer, which reduces logistics costs and facilitates its use in rural areas with limited infrastructure. In addition, its solid presentation and controlled palatability contribute to a more homogeneous consumption between flock animals, avoiding nutritional imbalances caused by food competence or excessive consumption of certain individuals.

From the nutritional point of view, the BMN formulation should be based on rigorous technical criteria to ensure that animals receive the necessary nutrients in adequate proportions. The inclusion of non -protein nitrogen, such as urea, must be carefully controlled within the solid matrix of the block to avoid poisoning. This approach contributes not only to improve the digestibility of dry fodder, but also to maximize the use of nitrogen by rumen microorganisms, which translates into a better animal performance (Aburto, 2022)

During drought periods, when natural grass is insufficient or poor, providing adequate supplementation containing energy, proteins, vitamins and minerals is essential to maintain the physiological and productive state of livestock. As Graillet-Juárez et al. (2017), the lack of these nutrients can lead to important losses of weight, reduction in milk production, lower fertility and greater susceptibility to diseases.

BMNs are designed precisely to face these seasonal deficiencies, providing a balanced mixture of macronutrients and micronutrients that supports productivity and animal health at critical moments. Godoy et al. (2020) indicate that this technology represents a key tool to ensure the well -being of the flock and mitigate the negative effects of environmental stress associated with forage shortage.

In addition to their nutritional value, BMNs have a positive effect on the economy of producers. By reducing dependence on expensive commercial supplements and promoting the use of local resources, multinutritional blocks are aligned with the principles of sustainability and circular economy. This practice also encourages rural innovation and the resilience of agricultural systems against climate change (Chafla et al., 2020)

In the BMN formulation, various optional ingredients can be incorporated according to regional availability and livestock needs (Cordao et al., 2018). For example:

**1. Fiber sources:**

Fibers play an important role as physical and energy support. Short fiber sources include chopped corn cobs, coffee peels, wheat bran, oleaginous seed cakes (such as cotton or peanuts) and rice powder. On the other hand, long fibers can come from cane bagasse, chopped hay, banana peels or dry African palm. The inclusion of protein -rich fibrous ingredients, such as palm leaf cakes, improves the total protein content of the block.

**2. Energy sources**:

Caña molasses is one of the most used energy ingredients due to its availability and low cost, especially in sugar -producing countries. You can also use African palm oil or recycled vegetable oil, in controlled proportions, generally mixed with molasses to improve its palatability and ensure its consumption.

**3. Mineral sources**:

Mineral supplementation is essential to guarantee optimal growth and production. In the BMN, essential minerals can be incorporated such as calcium, phosphorus, sodium, magnesium and trace elements. These not only improve the nutritional profile, but also increase the palatability of the block, favoring their regular consumption.

An important aspect is that BMN can help regulate salt consumption in cattle, reducing their direct inclusion in the diet. The combination of ingredients in the block matrix allows more effective control of voluntary consumption, which also contributes to better digestive and metabolic health.

Despite the multiple advantages offered by multinutritional blocks, Rodríguez-Molano & Pulido-Suárez (2018) insist that its effectiveness depends largely on its correct formulation. It is not enough that the supplement is practical or economical; It must provide a complete and balanced nutritional profile that responds to the physiological demands of the animal

in each productive stage. Therefore, the design and evaluation of BMN should be based on solid technical criteria and scientific evidence (Francigefeson et al., 2017)

Therefore, the use of multinutritional blocks represents a promising strategy to improve the efficiency of livestock production in tropical conditions, especially during the dry season. Their low cost, ease of handling and potential to take advantage of local resources make them a key tool for the sustainability of agricultural systems. However, to maximize its benefits, it is essential to continue investigating its formulation, adaptability and long - term effects in different productive contexts (Furtado et al., 2018)

## MATERIALS AND METHODS

An exhaustive bibliographic review was carried out from two academic databases of recognized prestige, Scopus and Google Scholar. The purpose of this review was to analyze the use of multinutritional blocks (BMN) in various species of ruminants, in order to address several aspects related to animal production, such as weight gain, meat quality and dairy production. In total, 30 scientific articles for analysis were selected, of which 8 were obtained through the Scopus and 22 platform through Google Academic. These articles were carefully reviewed and, subsequently, the data extracted underwent a meta -analysis.

To structure meta -analysis, the studies were categorized according to different aspects related to the use of BMN in ruminants, which allowed to identify specific trends and patterns in supplementation with multinutritional blocks. The categories under which the studies were grouped were the following:

1. Weight increase in calves and heifers.
2. Weather weight gain.
3. Weight increase in bulls.
4. Milk production in cows.
5. Milk production in goats.
6. Gas and production weight gain and production.
7. Gas gain and production increase in sheep.
8. Weight increase in sheep.
9. Quality of the housing in lambs and kids.

10. Use of pastures in sheep.
11. Effectiveness of anthelmintics in sheep.
12. Weight increase in goats.
13. Digestibility in deer.
14. Milk production in YAKS.
15. Chemical and nutritional composition of multinutritional blocks and the ingredients used in its formulation.

The variables included in the selection of the articles were those scientific publications that addressed the use of multinutritional blocks in ruminants. Special attention was paid to those studies that explored BMN supplementation in various species of ruminants, such as the improvement in meat production in cattle, sheep, goats and deer, as well as dairy production in cows, goats and yaks. In addition, articles that provide details about the chemical and nutritional composition of the multinutritional blocks and the ingredients used in their formulation were considered.

With respect to the exclusion criteria, it was established that the scientific articles published before 2017, thesis, non -academic web documents, technical notes, dissemination articles, videos, interviews or any other source not directly related to scientific literature would not be considered. This approach was adopted in order to ensure that the information analyzed outside the highest scientific and academic quality available, limited to research that would be published in indexed scientific journals with a high impact factor. The Scopus and Google academic platforms were selected due to their recognized reliability and accessibility to great prestige magazines in the academic field, which facilitated obtaining relevant and up -to -date studies.

The process of compilation of the articles was based on a detailed analysis of indexed publications on these platforms. The articles were selected from the results obtained in specific searches on the issue of multinutritional blocks in ruminants. The search focused on key terms related to nutritional supplementation in ruminant animals, improvement in productive efficiency, weight gain, meat quality, dairy production, and nutritional composition of multinutritional blocks.

Once the articles were obtained, a data extraction process was carried out in which the main variables and results of each study were collected. These data were organized and classified according to the categories mentioned above, thus allowing a meta -analysis that allowed to identify general trends on the impact of BMN in the different areas of animal production.

This meta -analysis, based on the review and analysis of the selected items, seeks to provide an integral vision on the use of multinutritional blocks in ruminants. The objective is to evaluate in a quantitative and qualitative way the benefits and possible negative effects of BMN supplementation in different species, as well as identify the factors that can influence the effectiveness of these nutritional supplements.

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It is important to note that, given the approach and the established inclusion criteria, the results of this meta -analysis are backed by high quality scientific research, which ensures that the information obtained is representative and relevant to the academic and professional field of animal nutrition. The Scopus and Google Academic database, together with the strict inclusion and exclusion criteria, provided a robust and reliable sample of recent scientific studies, which reinforces the validity of the conclusions obtained in this research.

Therefore, this study aims to analyze and evaluate the impact of multinutritional blocks on the animal productivity of ruminant species, with a particular approach in the improvement of performance in terms of weight gain and dairy production. The collection and analysis of the most relevant and up -to -date studies provides a solid basis for making informed decision making on the use of these nutritional supplements in modern livestock.

## RESULTS

In this research, a review of scientific articles published between 2017 and 2024 was carried out, in the Databases of Scopus and Google Scholar, in order to obtain relevant

information on the use of multinutritional blocks (BMN) in ruminants. In total, 30 articles that address various BMN applications in animal production were identified. Next, the results obtained, organized by the main research issues identified in the revised literature are presented.

Distribution of investigated topics

Of the 30 selected articles, the most investigated themes were those related to the improvement of milk production and weight gain in ruminants, especially during periods of forage shortage, as is the case during droughts. The results revealed the distribution of the articles on the following topics:

Milk production in cows (16.66%): This issue was the most commonly investigated, with a total of 5 articles that address the impact of multinutritional blocks on milk production in dairy cows. BMN supplementation in cows has shown a positive effect on improving dairy production, especially in limited grazing conditions.

BMN composition (26.66%): Eight articles focused on the nutritional composition of multinutritional blocks, a key aspect to guarantee their effectiveness in animal supplementation. These studies were fundamental to understand the different ingredients used in the formulation of the blocks and their impact on the productive performance of the animals.

Weight increase in ruminants (13.33%): In total, 6 articles were found that investigated the weight gain of different types of ruminants. Of these, 1 article focused on the weight gain of calves and heifers (3.33%), 1 in brothers (3.33%), 1 in bulls (3.33%), 1 in sheep (3.33%), 1 in goats (6.66%), and 1 in steers (3.33%). The results in these studies show that multinutritional blocks help improve efficiency in the conversion of fodder into body weight, even in limited grazing conditions.

Housing quality in lambs and kids (6.66%): Two studies focused on improving the quality of the housing in lambs and kids. The results suggest that BMN can have a positive effect on meat quality, optimizing nutrient conversion and favoring fat and muscle deposition in minor species.

Use of pastures and antihelmintics in ruminants (13.33%): Several articles also investigated the use of pastures in sheep (3.33%) and the impact of antihelmintics in sheep (3.33%) and

goats (3.33%). BMN supplementation in combination with pasture management strategies and parasite control seems to improve the health and productive performance of animals.

Milk production in goats and yaks (6.66%): 2 articles were found that approached the effect of BMN on milk production (3.33%) and YAKS (3.33%). These studies highlight the BMN potential to increase dairy production in species other than cows, especially under restricted grazing conditions.

Digestibility in deer (3.33%): An article focused on the digestibility of nutrients provided by BMN in deer. The results showed that multinutritional blocks can improve the digestibility of forages in wild species, which in turn improves the efficiency of food conversion.

## DISCUSSION

The use of multinutritional blocks (BMN) as a supplementary strategy in the feeding of grazing ruminants has gained significant importance in the context of climate change, particularly during drought periods. According to the review of 30 scientific articles published between 2017 and 2024, it is evident that BMNs have been subject to different species and productive contexts, highlighting their impact on weight gain, dairy production, channel quality, digestibility and use of forage resources, as well as their potential as an antiparasitic alternative.

The main findings indicate that 26.66% of the studies focused on the formulation and composition of the BMN, while the rest explored their direct effects on productive variables such as weight gain (divided between cattle, sheep and goats), production of milk in cattle, goats and yaks, quality of channel in sheep and kids, as well as its antiparasitic and digestive impact.

During times of fodder shortage, the BMN supply represents a strategic solution to maintain productivity and livestock profitability. Its inclusion allows optimizing efficiency in food conversion, improving the use of available resources, and reducing dependence on expensive inputs. Likewise, a balanced supplementation contributes to animal welfare, minimizing nutritional deficiencies and associated metabolic diseases. In the same way, its application strengthens the resilience of productive systems, ensuring economic and environmental sustainability in the long term.

Various regional studies have validated these benefits. In Venezuela, Romero-Marcano et al. (2020) analyzed the partial or total replacement of corn's malorjo by BMN for growing cattle. Although no significant differences were observed in the variation in weight between treatments, a sex effect was detected, with greater losses in males. This suggests that the Bora is not an effective replacement for the malico, at least in developing cattle, and highlights the need to evaluate biological factors along with nutritional by the BMN formulate.

In Mexico, the results of Pacheco et al. (2019) showed that BMN supplementation in Novillonas under intensive grazing increased daily weight gain with respect to the control group. This evidence was backed by a robust experimental design and statistical analysis by ANOVA and Duncan test, confirming the effectiveness of BMN in intensive management contexts.

Similarly, Graillet-Juárez et al. (2017) reported a significant increase in productivity and profitability in bulls supplemented with BMN, who reached an average daily weight increase of 494 g compared to 398 g in the group without supplementation. This increase was translated into an additional daily utility of USD 1.20, which accumulated in 90 days represented a gain of USD 108.00 per animal, underlining the tangible economic value of this food strategy.

In El Salvador, Cardoza et al. (2017) evaluated the effect of different BMN preparation procedures on milk production and profitability in cows. During the rainy season, the cows that voluntarily consumed BMN produced on average 5.35 kg/milk day, compared to 4.99 kg/day in the control group ($p = 0.018$). The profitability, although modest (USD 0.096 per cow/day), was positive, with a cost of making the USD 3.0 Block. This study highlights the importance of voluntary consumption as a critical variable to consider in the implementation of BMN.

For its part, Godoy et al. (2020), in Peru, investigated the inclusion of agroindustrial waste in the BMN formulation and its impact on milk composition and production. Its cross design allowed us to observe that supplementation significantly improved the nutritional composition of the diet, in particular protein and fiber levels, without negatively affecting the quality of the milk produced. This innovative approach not only reduces costs, but also promotes the circular economy and the use of by -products.

The results analyzed agree that BMN can improve both zootechnical parameters and the economic indicators of animal production units. However, it is crucial to consider contextual factors such as the type of base fodder, the physiology of the animal, the specific formulation of the block, and the local climatic conditions to maximize its benefits. The variability between studies suggests that the BMN formulation must be adapted to each productive system through a comprehensive and evidence -based approach.

In terms of health and animal welfare, the use of BMN has also shown indirect benefits, such as the reduction of the use of chemical antiparasitics in sheep and goats, which contributes to more sustainable and safe production practices for the environment and the consumer. This characteristic is especially relevant in organic or agroecological systems, where the use of synthetic drugs is limited.

Finally, from a strategic perspective, the development and implementation of BMN strengthens the ability to adapt the livestock systems against adverse climatic scenarios, allowing maintaining the continuity of production with efficiency and resilience. Future research should be aimed at standardizing evaluation methodologies, comparing formulas at the regional level and exploring new sources of local ingredients or agribusiness waste to improve the sustainability of its use.

## CONCLUSION

The compiled evidence suggests that most studies on multinutritional blocks (BMN) have focused mainly on their nutritional composition, and secondly, on their use as a supplement to increase milk production in cattle. However, there is a clear need to expand research towards its application in the production of meat in grazing systems, particularly during the time of Estiaje.

The scientific development around BMN represents a relevant contribution to agricultural knowledge, since it promotes more efficient food practices, promotes improvements in health and animal productivity, and contributes to the profitability of livestock units. These innovations are key to face the challenges of livestock production in adverse environmental conditions.

**Recommendations**

1. Optimize formulations to better adapt them to the nutritional needs of livestock during periods of drought.

2. Perform cost-benefit analysis that evaluate their economic viability

3. Move towards more sustainable alternatives that consider the environmental impact of the use of these supplements.

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