

Use of millet in the nutrition of ruminant animals

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ABSTRACT

Nowadays, the use of millet in animal nutrition has been shown to be of great importance in Brazil, especially due to its agronomic and nutritional characteristics that make it a viable and efficient option for feeding ruminants such as cattle, buffaloes, goats and sheep.

Keywords: Millet, Ruminants, Animal nutrition, Bovines, Bubalinos, Caprinos, Ovinos.

INTRODUCTION

Brazilian livestock is deeply interconnected with the use of several types of pastures, the national herd demonstrates a growing dependence for the optimization of forage production, since these roughages constitute the basis of the diet in ruminants. In this scenario, pearl millet emerges as a strategic alternative for the dry season, due to its high hardiness and adaptability. It is a crop that can be directly grazed by animals, fully meeting their nutritional requirements, thanks to its high nutritional value. In addition, millet silage has a robust nutritional composition, making it an efficient solution for conservation and supply to animals during the dry season, when forage production is limited.

MATERIALS AND METHODS

This abstract was prepared from the analysis of research projects described in theses and dissertations on what pearl millet is, its advantages, nutritional value, how it is applied and provided in the diet of ruminant animals. Millet (*Pennisetum glaucum*) is an annual grass of tropical and subtropical climate, widely used in agriculture and livestock due to its versatility and adaptability to different environmental conditions. Originally from Africa, millet is known for its hardiness and ability to grow in poor soils and under adverse climatic conditions, such as high temperatures and low water availability

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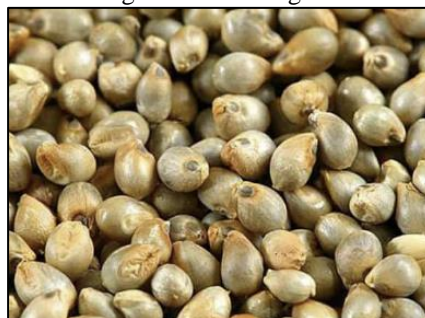
(Magalhães et al., 2018). Millet is an upright plant, reaching heights between 1.5 and 3 meters. It has robust stems and broad leaves, with inflorescences in the form of a compact panicle, the seeds are small and vary in color, and can be white, yellow, gray or brown. This phenotypic diversity allows millet to adapt to a wide range of ecosystems (Silva & Souza, 2020).

Figure 1 – Cultivation of millet



Millet is highly valued in livestock farming for its high nutritional value. Its leaves and stems are rich in protein, fiber, and essential minerals, making it an excellent forage option for animal feed. It can be used both in the form of direct grazing and in silage production. Millet silage has a balanced nutritional composition, being an effective alternative for periods of scarcity of other forages, such as during the dry season (Lopes et al., 2019). In addition, millet grains are an important source of energy and nutrients, and can partially or totally replace corn and sorghum in feed formulations for several animal species. Grains have high levels of carbohydrates, proteins, and lipids, contributing to the productive performance of animals (Ferreira et al., 2017).

Figure 2 – Millet grain



The pearl millet crop offers several agronomic advantages, among which the following stand out: **Hardiness and Tolerance to Environmental Stresses:** Millet is able to grow in soils of low fertility and resist prolonged periods of drought, which makes it a viable option in semi-arid regions and in marginalized soils (Gomes et al., 2021); **Nutrient Cycling:** Deep millet roots improve soil structure and promote nutrient cycling, benefiting subsequent crops (Oliveira & Santos, 2022); **Erosion Control:** Due to its rapid soil cover, pearl millet is effective in controlling erosion by protecting the soil against the



erosive action of rainfall (Mendes et al., 2020); **Crop Rotation and Pest Control:** The inclusion of pearl millet in crop rotation systems can reduce the incidence of pests and diseases, as well as break weed cycles (Almeida et al., 2018); **Source of Energy and Protein:** Millet has a nutritional profile that is comparable to corn, with a high digestible energy content, which makes it a good source of energy for ruminants. In addition, it contains significant levels of crude protein, which is essential for the growth and milk production of animals; **Digestive Health:** As an effective source of fiber, millet helps maintain rumen health by promoting proper fermentation and the production of volatile fatty acids, which are critical for ruminant energy; **Improved Milk Production:** Studies indicate that millet-based diets can improve milk production and composition by increasing fat and protein content, which is beneficial for milk quality. The nutritional composition of millet varies depending on the cultivar and growing conditions, but in general, it is an excellent source of energy, protein, fiber, minerals, and vitamins.

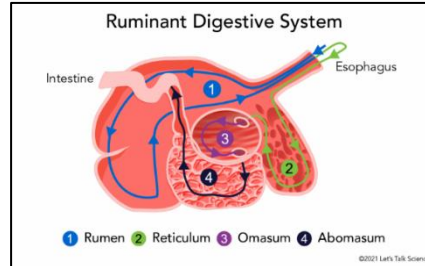
- Gross protein: 8-13%
- Crude fibre: 8-10%
- Dry matter: 65-70%
- Metabolizable energy: 3.0 – 3.3 Mcal/kg
- Minerals: phosphorus (0.3% to 0.4%) and calcium (0.04% to 0.08%).
- B vitamins such as niacin, thiamine and riboflavin, which are important for the energy metabolism of ruminants

Forms of Use in the diet of ruminants: Millet grains: Used whole, broken or ground in feed; Green Forage: Cut and supplied fresh; Millet Silage: Conservation for periods of scarcity; Millet Hay: Harvested and dehydrated as a source of fiber.

Ruminant animals: Ruminant animals are herbivorous mammals with an extremely specialized digestive system, known as the ruminant digestive system. This system is made up of four main compartments in the stomach: rumen, reticulum, omasum, and abomasum. The distinguishing feature of ruminants is the ability to regurgitate partially digested food from the rumen back into the mouth for rumination, where it is chewed again before being swallowed and moving on to the remaining compartments of the stomach. **Ruminant Digestive System: Rumen:** The largest compartment, which acts as a large fermentation tank, here, a specialized microbiota composed of bacteria, protozoa and fungi ferments plant foods, breaking down cellulose and other fibrous components into simpler substances such as volatile fatty acids and gases. These products are then absorbed by the animal for energy and nutrients; **Reticulum:** Works closely with the rumen, helping to mix and move food. Also known as a "honeycomb" due to its appearance, this compartment is also responsible for capturing and secreting accidentally

ingested foreign objects; **Omasum**: Also called "leafy" due to its numerous blades, the omasum absorbs water and nutrients from partially digested food, compacting it before moving into the abomasum; **Abomaso**: The true stomach of ruminants, where digestive enzymes and hydrochloric acid further break down food, allowing the absorption of nutrients in the small intestine.

Figure 3 – Digestive system of Ruminants



RESULTS

The use of pearl millet in the diet of goats and sheep has been highlighted as a promising option due to its agronomic and nutritional characteristics. In addition, its nutritional composition is favorable for ruminants, offering a rich source of easily digestible carbohydrates, quality proteins, and essential minerals, aiming not only to meet the nutritional needs, but also to maximize the productivity and health of these animals. The Boer Goat breed, known worldwide for its excellence in meat production and milk production, shows a remarkable adaptation to the consumption of various forages, including millet. Originally from South Africa, Boer is renowned for its robustness, feed efficiency and ability to adapt to varied environments.

When fed millet, goats of this breed can benefit as it is rich in essential nutrients for goats, such as easily digestible carbohydrates, good quality protein, and minerals such as phosphorus and calcium. This nutritional composition contributes to healthy growth, muscle development, and maintenance of the animal's overall health, thus facilitating satisfactory weight gain in a short period.

Figure 4 – Caprino Farmer Goat



The Santa Inês breed (sheep) originates from Brazil, more specifically from the Northeast region. It arose from the crossing of native breeds with sheep of the Bergamacia breed, imported from Italy. The process of selection and genetic improvement over the years has resulted in a breed with specific characteristics for meat production. One of the main characteristics of the Santa Inês breed is its high adaptability to different environmental conditions, they are rustic sheep, capable of developing well in arid and semi-arid regions, where other breeds could have difficulties due to the scarcity of resources. In addition to the excellent quality meat, the Santa Inês breed is also valued for its fur production, its genetic characteristics have been exploited to improve herds in different parts of the world, especially in areas with climates like Brazil. Just like in goats when fed millet, which has rich nutrients such as phosphorus, calcium, easily digestible carbohydrates and good quality proteins, this nutritional contribution contributes to muscle development, healthy growth and good health of the animal.

Figure 5 – Santa Inês Sheep



In the nutritional diet of ruminants, as well as in goats and sheep in cattle and buffaloes it is no different, offering a promising alternative to traditional concentrated feeds and forages, this cereal has unique characteristics that make it a viable choice for feed supplementation of these animals, especially in regions where adverse climatic conditions can affect the availability and quality of food resources. Several breeds of cattle and buffaloes have shown the ability to adapt to the consumption of millet in their diet. Breeds such as Nelore, Guzerá, Gir (cattle) and Jafarabadi, Murrah (buffaloes), are common examples in Brazil that benefit from the inclusion of this cereal in their feeds, taking advantage of its nutrients and helping to maintain a balanced diet throughout the year. Studies have indicated that the strategic inclusion of millet in the feed of these animals not only contributes to the sustainability and efficiency of livestock systems, but can also improve the health and productive performance of cattle and buffaloes. This cereal therefore represents a valuable and sustainable option for animal nutrition, promoting both animal welfare and the profitability of producers. In Brazil, several breeds of cattle are known to consume millet in their diets, especially in regions where this cereal is cultivated and available as feed for livestock. Nelore is a Zebu breed originally from India, adapted to the tropical climate of Brazil, known for its resistance to

tropical diseases and adverse conditions, used mainly for meat production, being one of the most popular breeds in the country. Millet is used in the Nellore diet mainly in the form of silage, hay and also in crushed grain, providing energy and essential nutrients.

Figure 6 – Nellore cattle



Guzerá, also of Indian origin, adapted to the tropical climate, recognized for its rusticity and adaptability to different types of food, is used both for meat production and for industrial crossbreeding. Like Nellore, millet is integrated into the diet of the Guzeras to supplement their nutritional needs.

Figure 7 – Guzera cattle



As for buffaloes, we find the Murrah breed originally from India, it is the most predominant among buffaloes in Brazil, adapted to the tropical climate, is known for its resistance to heat and humidity, produces excellent quality milk, with a high fat and protein content, being used both in milk production and in fattening for meat. It has a varied appetite, adapting well to different types of food, including millet when available in its nutritional diet.

Figure 8 – Bubalino Murrah



Also of Indian origin, the Jafarabadi breed is found in Brazil and adapted to tropical conditions, it is known for its hardiness and resistance to diseases, used mainly for meat production, it has a good use of alternative forages such as millet, contributing to its balanced nutrition.

Figure 9 – Bubalino Jafarabadi



FINAL CONSIDERATIONS

This paper aims to inform what millet is and its use in the diet of ruminants, such as goats, sheep, cattle and buffaloes. These species play a crucial role in Brazilian livestock, especially in regions where climatic conditions challenge sustainable food production. This cereal offers a nutritious and economical alternative, enriching the diet of animals with carbohydrates, proteins and essential minerals, for their growth and productive performance. In addition to helping diversify food sources for ruminants, millet can also reduce feed costs, improve feed efficiency, and promote environmental sustainability by reducing pressure on natural resources. For the Brazilian market, the strategic use of millet represents an opportunity to increase the competitiveness of livestock, offering an effective response to the climatic and economic challenges faced by producers.



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