Economic feasibility of diets containing different nitrogen sources as a function of weight gain in Saanen breed goats

Viabilidade Econômica de dietas contendo diferentes fontes de nitrogênio em função do ganho de peso de caprinos da raça Saanen

DOI:10.34117/bjdv6n3-102

Recebimento dos originais: 10/02/2020
Aceitação para publicação: 09/03/2020

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ABSTRACT
The use of a low cost protein input results in improvements in animal zootecchnical indices. The aim of this study was to evaluate the cost of diets containing different nitrogen sources as a function of weight gain in Saanen goats. Eighteen 150-day-old Saanen goats were randomly divided into two groups: control group (CG) and urea group (UG). At the beginning of the experiment and every 7 days, before feeding, the animals were weighed on a mechanical platform scale to obtain live weight over a period of 121 days. The prices of the dietary ingredients were obtained from the local market of Seropédica - RJ, from April to June 2019. For statistical analysis, the GraphPad PRISM 5® software was used. The use of soybean meal or urea in the diet did not influence animal performance in relation to daily weight gain. The difference in values may not appear to be attractive, but the amount of urea used in ruminant diets is much smaller when compared to the amount of soybean meal, which reflects in the final diet price, making urea make a source more viable for the producer.

Keywords: cost, goat farming, soybean meal, sustainability, urea

RESUMO
O uso de proteínas de baixo custo resulta em melhorias nos índices zootécnicos dos animais. O objetivo deste estudo foi avaliar o custo de dietas contendo diferentes fontes de nitrogênio em função do ganho de peso em cabritos da raça Saanen. Dezoito cabritos Saanen com 150 dias de idade foram divididos aleatoriamente em dois grupos: grupo controle (GC) e grupo ureia (GU). No início do experimento e a cada 7 dias, antes da alimentação, os animais foram pesados em uma balança de plataforma mecânica para obter peso vivo por um período de 121 dias. Os preços dos ingredientes alimentares foram obtidos no mercado local de Seropédica - RJ, de abril a junho de 2019. Para a análise estatística, foi utilizado o software GraphPad PRISM 5®. O uso de farelo de soja ou uréia na dieta não influenciou o desempenho dos animais em relação ao ganho de peso diário. A diferença nos
valores pode não ser atraente, mas a quantidade de ureia utilizada nas dietas de ruminantes é muito menor quando comparada à quantidade de farelo de soja, que reflete no preço final da dieta, tornando a ureia uma fonte mais viável para o produtor.

**Palavras-Chave:** custo, caprinocultura, farelo de soja, sustentabilidade, ureia

**1 INTRODUCTION**

In any system of raising ruminants, whether in grazing or confinement, the consumption of quality food with high nutritional value determines the supply of nutrients to meet maintenance and production requirements (DETMANN et al., 2007). In Brazil, the feeding of ruminants is predominantly based on grazing animals, being which is impaired in certain periods of the year, due to the low quality and / or availability of pastures, leading to a decline in productivity indexes (SILVA et al., 2015).

This fact represents a deficiency in the production system, since, when higher levels of productivity are sought, it is necessary to increase the nutritional value of the diets, therefore requiring a supply of concentrate to supply the animals’ needs (BOLZAN et al., 2007).

Among the nutrients present in the diet, protein is the main limiting factor for ruminants, especially during the dry season in grasses of tropical or subtropical climate. It is noteworthy that there are two fractions of protein contained in the food of ruminants, the degradable fraction in the rumen and a non-degradable fraction in the rumen (SOUSA et al., 2018).

Ruminants, through microorganisms present in the rumen, are able to transform both the nitrogen derived from the true protein, and that from some non-protein nitrogenous compounds, such as urea, ammonium sulfate and biuret, into protein of high nutritional value (RIBEIRO et al., 2014). Currently, urea is widely used in balancing diets to adjust the levels of degradable protein in the rumen (SOUZA et al., 2015), and the use of urea in concentrated foods allows to save inputs without compromising the productivity of the animals, being a widely used form, with the objective of reducing costs in this type of food (VOLTOLINI et al., 2010).

It is understood that the characteristics of goat meat, when added to the potential of herds, can encourage the commercialization of males of dairy origin and contribute to the economic sustainability of these production systems.

However, due to the high prices of concentrates and knowing that they are indispensable in a confinement regime, it is pertinent to look for cheaper protein alternative foods, such as urea, which can reduce production costs and ensure greater product competitiveness.

The discussion on the feeding of humans and animals, as well as productive sustainability, begins with the question about the possibility of the land feeding billions of living beings, without irreversibly degrading it, while guaranteeing health and well-being of all.
Morin (2013) points out that the "problem of agriculture is planetary in scope, inseparable from the problem of water, demography, urbanization, ecology (climate change), as well as, undoubtedly, food, these same problems being interdependent each other ".

In the livestock production scenario, we use soy as a protein base in animal feed, a food increasingly used in human food as a source of vegetable protein. The use of inputs in animal production that are used directly in human food, contribute to the price of the product to increase significantly, reducing the feasibility of its use in feeding large herds.

In view of this, the use of a low-cost protein supply, which results in improvements in the zootechnical indexes of animals (YÁÑEZ et al., 2007) could be an alternative source in the feeding of ruminants. Thus, the aim of this study was to evaluate the economic feasibility of diets containing different sources of nitrogen as a function of weight gain in Saanen goats.

2 MATERIAL AND METHODS

The survey was developed in the Goat Sector of the Federal Rural University of Rio de Janeiro (UFRRJ) in the municipality of Seropedica - RJ, at 22°47'04 "south latitude and 43°40'50" west longitude and 26 meters of altitude, where the climate of the region is of the type AW (Köppen), with a dry season that extends from April to September and another hot and rainy season, from October to March.

Eighteen 150-day old Saanen goats were used, from simple and double births, being randomly divided into two groups: control group (CG) and urea group (UG). These were dehorned, de-wormed and kept in two collective pens each measuring 15.0 m².

The experimental design used was completely randomized, with two treatments and nine repetitions in each group. Two isoproteic diets with 12% CP were used, for gains of 150 g / animal / day, containing a ratio of 50:50 roughage: concentrated on the basis of dry matter (DM), being composed of 50% of the DM of hay Tifton 85 (Cynodon spp.) and 50% of DM of concentrate, without inclusion of urea in the control group or with 1% of urea in DM in the urea group, in addition to ground corn, soybean meal and minerals, according to nutritional requirements established according to the recommendations of the NRC (2007), in both diets. The percentage and chemical composition in dry matter of the experimental diets are shown in table 1.

The tifton hay, ground corn and soybean meal used in the formulation of the diet were subjected to determinations of dry matter (DM) and crude protein (CP) in the bromatology laboratory of the animal nutrition and pasture department of Federal Rural University of Rio de Janeiro, of according to the methodologies of Detmann et al. (2012).
To determine the dry matter, 3 g of the samples were weighed in porcelain crucibles, taken to the oven at a temperature of 100° C until constant weight. Then, the samples were weighed again, obtaining the amount of dry matter through the difference between the weights.

The crude protein was determined using the micro-Kjeldahl method, where 250 mg of the sample was digested with concentrated sulfuric acid in the presence of the potassium sulfate catalyst. In the distillation phase, the digested material was subjected to the reaction with a concentrated sodium hydroxide solution (NaOH) to release ammonia.

| Table 1 Composition of experimental diets (% DM). |
|-----------------------------------------------|
| Composition of ingredients | Control Diet | Urea Diet |
| Tifton hay (Cynodon spp.) | 50.00 | 50.00 |
| Ground Corn | 41.40 | 47.00 |
| Soybean Meal | 6.60 | - |
| Urea (% DM) | - | 1.00 |
| Calcitic Calcareous (% DM) | 1.50 | 1.50 |
| Dicalcium Phosphate (% DM) | 0.50 | 0.50 |

| Nutritional Composition | Control Diet | Urea Diet |
|-------------------------|--------------|-----------|
| Dry Matter | 88.24 | 88.09 |
| Crude Protein | 12.31 | 12.29 |
| Total Digestible Nutrients | 66.31 | 65.90 |
| Neutral Detergent Fibers | 45.63 | 45.37 |

The distillation product was received in a container with a solution containing 20 g boric acid (H₃BO₃) per liter and the methyl red and green bromocresol indicators. The nitrogen content of the samples was determined by titration with sulfuric acid (H₂SO₄) 0.1 N and the amounts of CP obtained from multiplying the total nitrogen content by a factor of 6.25 (considering that proteins have on average 16% nitrogen) (Table 2).

| Table 2 Food composition (%). |
|-------------------------------|
| Food | Dry Matter | Crude Protein |
| Tifton hay (Cynodon spp.) | 82.98 | 9.23 |
| Ground Corn | 87.64 | 7.29 |
| Soybean Meal | 89.12 | 44.73 |
The feed supplied twice a day, at 8:00 am and at 5:00 pm. The leftover ration was weighed daily on a digital scale to maintain a daily leftover of 20% of the supply and monitor dry matter consumption.

The animals had a period of adaptation to the diets of 14 days. Subsequently, during the adaptation period, they had their initial live weights (kg) assessed after fasting. This same deprivation period also used to measure live weight (kg) at the end of the experiment. The experimental period lasted 121 days.

This work submitted and approved by the Ethics Committee under registration number 0008-06-2018 (CEUA / IZ / UFRRJ).

At the beginning of the experiment and every 7 days, at 7:00 am in the morning, before feeding, the animals were weighed on a mechanical platform scale (Açores®, model 602 SM, Cambe - PR) to obtain live weight. The experimental period was 121 days.

To obtain economic viability, the prices in currency Real (R$) of the dietary ingredients were collected. These values were obtained in the local market in the municipality of Seropedica - RJ, between the months of April to June 2019.

For statistical analysis, the GraphPad PRISM 5® program was used. Data were tested for normality using the D'Agostino-Pearson test. Differences between treatments (GC vs GU) were analyzed using the t test (P < 0.05). The statistical model used consisted of the equation: Yij = m + Ti + eij. Where: Yijk = observed value of the variable studied in individual j, receiving diet i; m = constant associated with the observations, Ti = effect of diet i, ranging from 1 to 2, eijk = random error associated with each observation Yij.

### 3 RESULTS AND DISCUSSION

The use of soybean meal or urea in the diet did not influence (P > 0.05) the animals' performance in relation to daily weight gain (Table 3). The observed values were similar to those estimated based on the NRC (2007).

| Table 3 Animal performance and ingredient prices for different diets |
|---------------------------------------------------------------|
| **Animal Performance** | **Control Diet** | **Urea Diet** | **P value** |
| Initial Live Weight (kg) | 21.68 ± 0.83 a | 20.89 ± 0.61 a | 0.45 |
| Final Live Weight (kg) | 37.49 ± 0.92 a | 35.42 ± 1.87 a | 0.35 |
| Weight Gain (g / dia) | 132.9 ± 4.97 a | 122.1 ± 1.89 a | 0.42 |

Price (R$ / kg)
Soybean Meal   | 2.09  | -
Urea         | -     | 2.50
Corn Meal    | 0.67  | 0.67
Tifton hay   | 1.49  | 1.49
Mineral Salt for Goats | 5.59  | 5.59
Total        | 9.84  | 10.25

Different letters on the same line indicate that there was a statistical difference (P <0.05)

The animals reached a similar average weight between the groups with an average of 150 days of age, with no difference (P> 0.05) for the live weight, confirming that urea as a more economically viable nitrogen source can be used in total replacement of soybean meal without compromising performance.

According to Oliveira et al. (2014), Saanen goats being less specialized animals for meat production, show a later body development, implying in older age to reach the ideal weight for slaughter.

The Saanen breed is considered as large animals and high adult weight, which gives the growing goats great potential for weight gain, this probably explains the similarity of performance between the two groups receiving isoprotein diets.

In a survey carried out in the Baixada Fluminense region of the State of Rio de Janeiro in 2019 (Table 3), the soybean meal reaches the producer at an average price of R$ 2.09 / kg, while the price of urea arrives at average at R$ 2.50 / kg. The difference between the values may not seem attractive, but the amount of urea used in ruminant diets is much smaller when compared to the amount of soybean meal, which reflects in the final price of the diet, causing urea to become make a source more viable for the producer.

Currently, the internal and external scenario presents some factors that favor the development of goat agribusiness, making it possible to add value to production both domestically and internationally, on an unprecedented scale, given the real market opportunities (Table 4). Furthermore, there is a change in attitude on the part of food consumers, with a tendency mainly in developed countries that concerns about health and well-being in general, including environmental fears, become increasingly important in the process choice of consumers.

**Table 4 Price of meat (live weight) of goats in the main producing states in Brazil in December 2019**

| Producer state | Price in Reais per Kg (R$/Kg) of live weight | Rate of change |
|----------------|---------------------------------------------|----------------|
| Alagoas (AL)   | 6.24                                        | 0.00           |
| Bahia (BA)     | 5.45                                        | 0.00           |
This scenario, combined with the phenomenon of globalization, could boost the world consumption of goat meat. It should be noted that among the most consumed meats in the world, goat meat is the leanest (contains the lowest fat content), being even leaner than chicken meat. For example, for every 100 grams of meat roasted in the oven, goat meat has 2.75 grams of fat, against 3.75 grams of chicken, 17.14 grams of beef and 25.74 grams of pork. This differential, combined with strategies to conquer new markets, can considerably boost the world consumption of goat meat (DAYENOFF et al., 2019).

In summary, goat meat production in Brazil, despite the growing demand, still has a long period to go to conquer its own market. In this way, it will have to satisfy the prerequisites of increasing biological and economic productivity of the main factors of production and improving the quality of its products, objectives that are difficult to achieve without a simultaneous improvement in the management standards of its production units and of greater articulation between the various components of the production chain.

4 CONCLUSION

Although the value of the urea-containing diet is visually more expensive, the amount of the ingredient used in the formulation of the concentrate is much less when compared to the use of soybean meal. This fact makes the diet containing urea more economically viable for the producer that recreates male goats for slaughter, having as basis the same performance of the groups fed with the different diets.

ACKNOWLEDGEMENTS

This work was carried out with the support of the Coordination for the Improvement of Higher Education Personnel - Brazil (CAPES) - Financing Code 001

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