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# BROMATOLOGICAL ANALYSIS OF DIFFERENT DAIRY CATTLE CONCENTRATE COMMERCIALIZED IN THE VALLEY OF SÃO PATRÍCIO-GO

## ANÁLISE BROMATOLÓGICA DE DIFERENTES CONCENTRADOS PARA BOVINO LEITEIRO COMERCIALIZADAS NO VALE DO SÃO PATRÍCIO-GO.

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**Keywords:**
*Bromatological analysis, dairy cattle, nutrition, nutrients, labeling.*

## Abstract

The Brazilian legislation guarantees minimum levels of nutrients to animal feed, and this information on the label is used to make purchase decisions to obtain dairy cattle concentrate feed. It is necessary that the declared values on the labels be as precise as possible. The bromatological analysis allows us to verify the real nutrition values and help us purchase products that meet the needs of dairy cattle. The objective of this work was to evaluate the centesimal composition of three different commercial dairy cow concentrates and to compare these values with those declared on the labels. Physical chemical analysis was carried out to determine the acid detergent fiber (ADF), neutral detergent fiber (NDF), dry matter (DM), total protein (TP), total fiber (TF), minerals (M), fat (F), calcium (Ca) and phosphorus (P). The observed values (OV) were compared to the declared label values (DV) by the maker. Following the legislation, classification criteria were created for the adequacy of the labels: to conform label (C) - samples that presented label values different from those obtained by laboratory analysis. The maximum and minimum values from the laboratory analysis were compared to the values permitted by the Brazilian Agriculture Ministry. The results were submitted to ANOVA and Tukey's test at 5% significance to verify the interactions between the averages. The dairy cow concentrates studied at Vale de São Patrício were considered good quality, and they met Brazilian legislation parameters. Through laboratory analysis, we verified that there was no difference between samples A, B and C in terms of humidity, dry matter, total protein, fat, minerals, calcium and phosphorus levels. However, it was observed that the relation between the declared label values and the results from laboratory analysis differed for some nutritional components of the studied commercial concentrates, such as humidity.

## Resumo

A legislação brasileira garante os níveis mínimos de nutrientes em ração animal e estas informações dos rótulos são usadas para tomar uma decisão de compra para aquisição de concentrados para ração bovina. Torna-se necessário que os valores declarados na rotulagem sejam o mais preciso possível. As análises bromatológicas permitem a verificação dos valores nutricionais reais e auxiliam na aquisição do produto que atenda às necessidades do gado leiteiro. O objetivo deste trabalho foi avaliar a composição centesimal de três concentrados comerciais para bovino leiteiro e compará-los com os valores declarados nos rótulos. Análises físico-químicas foram realizadas para se determinar os teores de fibra em detergente ácido (FDA), fibra em detergente neutro (FDN), Matéria seca (MS), Proteína bruta (PB), Fibra bruta (FB), Matéria mineral (MM) ou cinza, Extrato Etéreo (EE), Cálcio (Ca) e Fósforo (P). Os valores observados (VO) foram comparados com os valores declarados (VD) no rótulo pelo fabricante. De acordo com a legislação em vigor, criou-se o seguinte critério de classificação quanto à adequação de rótulo: em conformidade (C)- rações que apresentaram resultados da análise laboratorial de acordo com os valores declarados no rótulo; em não conformidade (NC)- rações que apresentaram resultados da análise não de acordo com os valores declarados. Os resultados das análises laboratoriais foram comparados com os valores mínimos e máximos permitidos pelo Ministério da Agricultura, Pecuária e Abastecimento. Os resultados obtidos foram submetidos à análise de variância ANOVA e ao Teste de Tukey ao nível de 5% para verificar an interação entre as médias. As rações para gado leiteiro avaliadas na região do Vale do São Patrício foram consideradas de boa qualidade e se encontravam de acordo com os parâmetros estabelecidos pela legislação. Através das análises laboratoriais, pode-se verificar que não houve diferença estatística significativa entre as amostras A, B e C nos quesitos: umidade, matéria seca, proteína bruta, cálcio, fósforo, extrato etéreo e matéria mineral. Entretanto, Observou-se que a consonância entre os teores declarados em rótulos e os valores obtidos através das análises bromatológicas, diferiram em alguns componentes dos concentrados comerciais estudados, como umidade, fibra bruta e fibra em detergente ácido.

## INTRODUCTION

Brazil came to occupy fourth place in the world ranking of milk production in 2015, with a national production of 35 billion liters, representing a decline of 0.4% compared to the previous year (IBGE, 2015). Between 2000 and 2013, Brazilian production increased by 73.3% against 28.3% of world production (EPAGRI/CEPA, 2015). National milk production is mainly concentrated in the Southeast and South regions, making up a total of 41.1% and 36.0%, respectively. The state of Santa Catarina is the fifth largest milk producer in the country, contributing to 9.8% of national production (CARVALHO, 2016). Constituting an activity of great socioeconomic importance for the state, it is estimated that currently, approximately 50 thousand producers obtain income from dairy activities (SANTOS et al., 2006).

Faced with the economic difficulties that affect Brazil, the prospect of a drop in GDP, continued high inflation and a decrease in employment and income, a reduction in milk production occurs and encourages farmers to reduce production costs (FAGUNDES, 2016).

One of the main factors that act directly on the economic relationship of the dairy sector is animal feeding, making up the majority of the costs involved in production (STELZER et al., 2009). Nutrition influences several other factors, such as health, productivity and reproductive performance, in addition to changing the quality of the product, which is very important for the dairy sector, as the milk market is increasingly moving toward valuing quality and not just quantity. Therefore, the diet provided to animals must be adequate to meet their nutritional demands in the most economical way possible, aiming, in addition, to reduce the environmental impact that can be caused by excessive nutrient intake (NRC, 2001).

For MAPA (2004), to be considered a protein concentrate, its formulation must include at least 20% crude protein in the concentrate, and its calcium/phosphorus ratio is acceptable at up to 7:1.

In this sense, the objective was to evaluate the consistency between the nutritional values declared on the labels of three commercial concentrates in Vale do São Patrício, intended for feeding dairy cattle, and values obtained by bromatological analysis.

## MATERIALS AND METHODS

Between the months of January and August 2019, three commercial crumble concentrates were randomly purchased, intended for feeding dairy cattle, identified as A, B and C to preserve the manufacturer's privacy. The concentrates were in plastic bags, and all products purchased were within their validity period.

The sampling process was adopted by collecting 10% of the batch of each commercial brand, where small aliquots were collected at different points of the packaging, manually, carried out on three different farms located in Vale de São Patrício.

Five hundred grams of sample was sent to the laboratory after the quartering technique (figure 1). The principle of the technique is that a quarter must be representative of the whole, in which any symmetrical food must be cut into four parts, and a quarter of each batch must be subjected to processing for analysis (ANNOR, 2009)

**Figure 1:** Quartering method


**Figure 2** : Precision balance.

The contents of acid detergent fiber (ADF), neutral detergent fiber (NDF), dry matter (MS), crude protein (CP), crude fiber (FB), mineral matter (MM), ash, and ether extract were determined. (EE), calcium (Ca) and phosphorus (P).

The observed values (VO) were compared with the values declared (VD) on the label by the manufacturer. In accordance with current legislation, the following classification criteria were created regarding label adequacy: in compliance (C) - feed that presented laboratory analysis results in accordance with the values declared on the label; nonconformity (NC) - feed that presented analysis results not in accordance with the declared values.

The results of the laboratory analyses were also compared with the minimum and maximum values allowed by the Ministry of Agriculture, Livestock and Supply (Brazil, 2002) in dry matter.

The analyzed values will be subjected to ANOVA of variance and the Tukey test at a level of 5% to verify the interaction between the means.

## RESULTS AND DISCUSSION

Protein is the most needed ingredient, after energy, for the development of metabolic functions in ruminants. The protein requirement of lactating cows occurs through the absorption of amino acids by the small intestine from true microbial protein, protein not degraded in the rumen and endogenous protein, which contribute to the supply of metabolizable protein. However, crude protein intake below 7% of the dietary DM leads to lower animal performance (VAN SOEST, 1994).

On the other hand, excess CP intake is related to higher dietary costs and greater excretion of urea in the urine, with wasted protein and energy. Variations in crude protein content in nitrogen compounds (PAIVA et al., 2013).

According to Paulino (2004), a 250 kg animal needs to have 6.16% dietary fat in its diet. However, this value may vary according to the animal's nutritional requirements.

In Table 1, it is possible to check the nutritional requirements of lactating cows, maintenance of dry cows at the end of pregnancy and the requirement

according to milk production. These data are important so that it is possible to formulate rations according to the requirements of each animal, relating to the condition in which it is found.

**Table 1.** Requirements for metabolizable energy (ME), total digestible nutrients (TDN), crude protein (CP), calcium (Ca) and phosphorus (P) for maintenance and milk production of cows with different live weights.

| **Maintenance of lactating cows** | | | | | |
|---|---|---|---|---|---|
| **Live weight** | **Energy** | | **PB** | **Minerals** | |
| **(kg)** | **In (Mccal)** | **NDT (kg)** | **(kg)** | **Ca (kg)** | **P (kg)** |
| 400 | 12.01 | 3.13 | 0.318 | 0.0160 | 0.0110 |
| 450 | 13.12 | 3.42 | 0.341 | 0.0130 | 0.0130 |
| 500 | 14.20 | 3.70 | 0.364 | 0.0200 | 0.0140 |
| 550 | 15.25 | 3.97 | 0.386 | 0.0220 | 0.0160 |
| 600 | 16.28 | 4.24 | 0.406 | 0.0240 | 0.0170 |
| 650 | 17.29 | 4.51 | 0.428 | 0.0260 | 0.0190 |
| 700 | 18.28 | 4.76 | 0.449 | 0.0280 | 0.0200 |
| **Maintenance of dry cows at the end of pregnancy** | | | | | |
| **(kg)** | **In (Mccal)** | **NDT (kg)** | **PB (kg)** | **Ca (kg)** | **P (kg)** |
| 400 | 15.26 | 4.15 | 0.890 | 0.0260 | 0.0160 |
| 450 | 16.66 | 4.53 | 0.973 | 0.0300 | 0.0180 |
| 500 | 18.04 | 4.90 | 1,053 | 0.0330 | 0.0200 |
| 550 | 13.37 | 5.27 | 1,207 | 0.0360 | 0.0220 |
| 600 | 20.68 | 5.62 | 1,131 | 0.0390 | 0.0240 |
| 650 | 21.96 | 5.97 | 1,281 | 0.0430 | 0.0260 |
| 700 | 23.21 | 6.31 | 1355 | 0.0460 | 0.0280 |
| **Milk production (kg nutrients/kg milk)** | | | | | |
| **(% of fat)** | **In (Mccal)** | **NDT (kg)** | **PB (kg)** | **Ca (kg)** | **P (kg)** |
| 3.00 | 1.07 | 0.280 | 0.078 | 0.00273 | 0.0017 |
| 3.50 | 1.15 | 0.301 | 0.084 | 0.00297 | 0.0018 |
| 4.00 | 1.24 | 0.322 | 0.090 | 0.00321 | 0.0020 |
| 4.50 | 1.32 | 0.343 | 0.096 | 0.00345 | 0.0021 |
| 5.00 | 1.40 | 0.364 | 0.101 | 0.00369 | 0.0023 |

Source: National ...(1988).

A cow consumes 1.8 to 2.2 kilos of dry matter for every 100 kilos of live weight. To feed a herd, the amount of feed per animal that represents the category average is calculated (NRC, 2001).

There was no significant difference between samples A, B and C for the following parameters: moisture, dry matter, crude protein, calcium, phosphorus, ether extract and mineral matter. However, there was a difference between the samples for the levels of crude fiber and acid detergent fiber, with sample A* having NDF and ADF values higher than those presented by commercial samples B and C. For the levels of neutral detergent fiber, it can be seen that samples A and C differed, but neither would differ statistically from sample B.

When comparing the guarantee levels of commercial concentrates for dairy cattle described in Table 2, it can be seen that the amount of EE in the samples was higher than those described in the guarantee levels informed by the manufacturer of feeds A and B.

What differentiates an energy concentrate from a protein is the level of protein included during its formulation. According to MAPA (2004), to be considered protein concentrate, its formulation must include at least 20% crude protein. As a result, the results of this study were lower than those described on the labels of the respective feeds analyzed for samples A, B and C, but they were within the standards established by legislation.

**Table 2** – Average contents of the proximate composition of three concentrates for dairy cattle sold in Vale de São Patrício-GO.

| SAMPLE | ONE | MS | PB | Here | P | AND IS | MM | FB | FDA | FDN |
|---|---|---|---|---|---|---|---|---|---|---|
| A | 10.36 to | 89.64 to | 23.81 a | 1.38 to | 0.34 to | 3.02 to | 7.43 to | 4.47 to | 7.13 to | 12.96 to |
| B | 10.93 to | 89.07 a | 25.08 to | 1.13 to | 0.47 to | 2.57 to | 6.28 to | 2.68b – | 4.76b – | 10.34 ab |
| W | 10.72 to | 89.28 a | 25.22 a | 0.91 to | 0.40 to | 2.46 to | 4.83 to | 2.28 b | 4.76b – | 10.00b – |
| Average | 10.67 | 89.33 | 24.70 | 1.14 | 0.40 | 2.68 | 6.18 | 3.14 | 5.55 | 11.10 |
| Standard deviation | 0.46 | 0.46 | 0.99 | 0.37 | 0.08 | 0.25 | 1.76 | 0.64 | 0.44 | 1.18 |
| CV (%) | 4.33 | 0.52 | 4.01 | 32.12 | 20.63 | 9.33 | 28.49 | 20.39 | 7.90 | 10.60 |

Means followed by letters in the column differ ($p<0.05$) using the Tukey test. Legend: moisture (UM), dry material (MS), crude protein (CP), calcium (CA), phosphorus (FO), ether extract (EE), mineral matter (MM), crude fiber (FB), fiber in acid detergent (FDA) and neutral detergent fiber (NDF) (g.100 $^{-100}$).

Table 3 shows the guarantee levels declared on the packaging of concentrates for dairy cattle sold in Vale de São Patrício-GO.

**Table 3.** Guarantee levels (%) declared on the labels of commercial concentrates for dairy cattle sold in Vale de São Patrício-GO.

| PRODUCER | A | B | W |
|---|---|---|---|
| Maximum humidity (g.100 g $^{-1}$) | 12 | 11 | 11 |
| protein (g.100 g $^{-1}$) | 24 | 26 | 24 |
| Ethereal extract (g.100 g $^{-1}$) | two | 2.4 | 2.8 |
| Crude fiber (g.100 g $^{-1}$) | 5 | 4.1 | 3.3 |
| Mineral matter (g.100 g $^{-1}$) | 9 | 0.8 | 7.5 |
| Calcium (MIN) (mg.100 g $^{-1}$) | 0.7 | 0.67 | 1.1 |
| Calcium (MAX) (mg.100 g $^{-1}$) | 1.25 | 0.82 | 1.3 |
| Phosphorus (MIN) (mg.100 g $^{-1}$) | 0.4 | 0.52 | 0.51 |
| FDA (MAX) (g.100 g $^{-1}$) | 6 | 0.6 | 5.38 |
| TDN (MIN) (g.100 g $^{-1}$) | 74 | 75 | 72 |

Oliveira et al. (2007) evaluated concentrates by determining the bromatological composition and the "in vitro" ruminal digestibility of dry matter and crude protein containing different levels of sunflower cake as a replacement for soybean meal in cattle feed. However, the results of the concentrate samples showed that the crude protein content was 19.46%, not in accordance with the values dictated by legislation, where this concentrate cannot be considered protein because it has less than 20% protein. raw in its composition.

MAPA is responsible for regulating feeds, provided by NORMATIVE INSTRUCTION No. 30, OF AUGUST 5, 2009 in.Art. 1st Regulate the packaging, labeling and advertising of products intended for animal feed. Food must present on its labels or packaging, at least, the following guarantees: I - humidity (maximum); II - crude protein (minimum); III - ethereal extract (minimum); IV - fibrous matter (maximum); V - mineral matter (maximum); VI - calcium (maximum) and calcium (minimum); and VII - phosphorus (minimum). The guarantee levels of

products intended for animal feed must be expressed in mg/kg when the concentration is less than 10,000 mg/kg and in g/kg when *it is greater than or equal to 10,000 mg/kg. Vitamins A, D and E must be guaranteed in IU/kg and vitamin B12 in µg/kg.

Several studies reported increases in feed consumption as the level of crude protein was increased from 18% to 24% (MEHEREZ & ORSKOV, 1978; VIEIRA et al., 1980) in cattle rations. For the tropics, dry matter (DM) consumption by ruminants can be considered to be approximately 3 to 5% of live weight (LW), depending on the physiological state of the animal (DEVENDRA, 1978, cited by LIZIEIRE et al., nineteen ninety). The effect of adding protein on consumption is felt most clearly when it is at very low levels, since a deficiency of degradable protein in the diet would limit microbial activity, thus affecting the intake and digestibility of nutrients (ORSKOV & ROBINSON, 1981).

Titi et al. (2000) compared the performance of ruminants fed diets containing different protein levels (18%, 20%, 24% and 26% CP) and found better performance with levels of 24 and 26% CP, which could be explained by the age of the animals used in the experiment and physiological stage. Normally, animals deposit more protein in the body during growth, indicating that they can use feed with higher protein levels (WIDDOWSON & LISTER, 1991).

Protein levels in the diet can influence the development of animals, increasing dry matter consumption and improving feed conversion and weight gain (FLUHARTY & MCCLURE, 1997; ZUNDT et al., 2002).

Estimates of the needs for mineral macroelements for cattle vary greatly between different committees, as shown in Table 4, with the main factors of variation being differences in the values adopted for maintenance requirements and the mineral absorption coefficient (ARC 1980; AFRC 1991; NRC 2000; CSIRO 2007). Mineral requirements are defined according to physiological activities, maintenance, weight gain, milk production, reproduction and endogenous, fecal and urinary losses (BALSALOBRE and RAMALHO, 2010).

Table 4. Calcium and phosphorus absorption coefficient values observed in the literature.

| Source | Absorption coefficient | |
|---|---|---|
| | Calcium | Phosphor |
| NRC (1980) | 0.68 | 0.60 |
| AFRC (1991) | - | 0.58-0.70 |
| NRC (1989) - Dairy cattle | 0.38 | 0.58 |
| NRC (1996) - Beef cattle | 0.50 | 0.68 |
| NRC (2001) - Dairy cattle (forage) | 0.30 | 0.80 |
| NRC (2001) - Dairy cattle (concentrate) | 0.60 | - |

Source: adapted from VALADARES FILHO et al. (2010)

According to Salman (2011), minerals are elements that perform several essential functions in the body, both as ions dissolved in organic liquids and as constituents of essential compounds. The Ca:P ratio in the cattle diet must be at least 2:1 to avoid metabolic problems, as they are the main constituents of bones. Forages can be good sources of calcium, especially legumes. Cereal grains tend to have higher P and K contents.

In the present work, the calcium and phosphorus ratio presented different values when compared to the values obtained in laboratory analyses with the guarantee levels on the labels. However, the values found were in accordance with the levels established by MAPA legislation (2004). These values

are corroborated by the results of BERALDO (2019), who found, for rations from three different properties evaluated, a ratio of 3.45:1, in compliance with MAPA legislation (2000), which has a maximum level of 7:1 for the ratio calcium and phosphorus.

Hansard et al. (1954; 1957) determined the true availability of calcium, maintenance requirements and utilization by cattle using radioisotopes of calcium, experimenting on animals that differed in age from 10 days to 190 months. Based on this work, the NRC (1984) began to recommend a daily net calcium requirement to maintain 15.4 mg/kg of body weight and maintained this recommendation in subsequent editions, NRC (1996) and NRC (2000), because there were no studies to recommend changes to this value. For lactating cows, there is an increase in the maintenance requirement to 31 mg/kg of live weight (MARTZ et al., 1990). This increase in lactating cows is due to increased dry matter intake that impacts intestinal calcium secretion during digestion (NRC, 2001).

Regarding the moisture content of the samples, it was observed that they were between 10 and 11%; however, when compared to the guarantee levels on the labels, they were below the declared value. However, these values are within the values permitted by Brazilian legislation (MAPA, 2000). The values in this work differ from the values found by BERALDO (2019), who evaluated the feed used for animals from three different properties and found moisture levels of 97.86%, 65.59% and 44.24%, with these values being higher. than those recommended by the Animal Nutrition and Food Norms and Standards (MAPA, 2000).

## CONCLUSION

The concentrates for dairy cattle evaluated in the São Patrício Valley region were considered to be of good quality.

Through laboratory analyses, it can be seen that there was no significant difference between the basic composition of concentrates A, B and C for the contents of moisture, dry matter, crude protein, calcium, phosphorus, ether extract and mineral matter. However, a close relationship was observed between the levels declared on the concentrate labels and the values obtained through bromatological analyses, differing in some components of the commercial concentrates studied, such as moisture, crude fiber and acid detergent fiber.

It is concluded that the concentrates of the main commercial brands for dairy cattle sold in Vale de São Patrício-GO are in accordance with the parameters established by Brazilian legislation and meet the nutritional needs of the animals.

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