Dietary Strategies for The Cow Calf Herd – The Experience of the Brazilian Beef Industry

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Introduction

Brazil is the fourth largest country in the world area wise and has an important beef cattle industry. It is estimated that the Brazilian cattle herd is around 213.5 million head, being 75 million breeding age beef cows. Beef production in Brazil has grown substantially in the last decade, and most of it is due to intensification of the production systems. The feedlot industry has experienced a large increase in the number of cattle fed and more cattle is correctly supplemented throughout the year according to season and forage quality. So, slaughter age has decreased and carcass weight has increased in the last decade around 20 to 25%. However, grass-fed beef is responsible for more than 90% of all beef produced in the country, as only 4.5 to 5 million animals are fed in feedlots, compared to 35 million finished on pasture (including cull cows).

On the beef cow side, less improvement has happened in the same period. Brazil is a large country, has very heterogenous production systems, and almost 100% of the beef cows are managed extensively on tropical pastures and rangelands. Even though the average herd size in the country is around 60 cows/operation, there are numerous ranches running over 10,000 to 30,000 cows, making their overall management an import challenge. It is important to note that the majority of the beef cattle herd is concentrated in the Midwest and north part of the county, encompassing the states of Mato Grosso, Goiás, Mato Grosso do Sul, Pará, and Rondônia. The states of Minas Gerais and São Paulo, in the southeast, also are two important states in terms of cattle number. Despite the large size, the average yield of beef per head is still very low. Having twice the number of cattle, Brazil produces less beef than the United States.

There are a lot of opportunities in the country to intensify beef production and the cow-calf segment in particular, which is the main target nowadays. The production of good quality calves has become the bottle neck of the Brazilian beef industry. Cattle prices sky rocketed in 2019 because of the high demand, mainly by the export market. China has been the main driver, and the availability of finished cattle ready for slaughter has not increased concurrently with demand. Thus, there is an increasing demand for high quality calves in order to fulfill the pressure for producing more beef.

The average weaning rate in Brazil as a whole is around 55 to 60%, and the main reason for this low number is poor nutritional management of the cows. Genetics, health, are other factors as well, but nutrition is by far the main hurdle. Professional ranches achieve weaning rates as high as 82 to 88%, and invest time and effort in

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better nutrition, genetics, people training, and overall management of the cows. The adoption of timed artificial insemination (**TAI**) has allowed an advancement in the use of better genetics, which in turn leads to investment in better nutrition as well. It is estimated that 15% of beef cows are under some type of TAI program in the country today. Just to give a better perspective, the sale of Angus semen has overtaken the sales of Nellore in the last 5 years. And that is an important change. Nellore, a breed originated from India, comprises over 80% of the Brazilian beef herd. Brazil imported Nellore dams/bulls in the early 50's and 60's from India to form the basis of the national herd and has implemented a serious genetic improvement program since then. Nowadays, the country has a very rich germplasm of *Bos indicus* Nellore breed that is very well adapted to the environmental conditions prevalent in Brazil. It's important to note that successful cattle operations in the tropics should comprise cattle that are physiologically and behaviorally adapted to the high ambient temperatures and humidity and low forage quality (Bell et al., 2017).

Nutritional Management of the Cow-Calf Herd

Similar to the USA, Brazil is a large country and the beef cattle production systems are very heterogeneous. There are markedly differences across the country in terms of precipitation, soil fertility, forage type, breed composition, management, herd size, etc., which impair the adoption of a common nutritional strategy to the cow herd. Depending on the resources available, the season and, as a consequence, forage quality and availability, the dietary strategies vary. However, considering the middle west region of the country, that concentrate around 60% of the national beef production, there is a clear division of the year into 2 main seasons: rainy/wet and dry season. The rainy season goes from October/November until February/March, and then the dry season follows until the rains start again in October / November of the following year. Beyond differences in precipitation between the rainy/dry season (1,200 to 3,000 mm vs. close to 0 mm), there are important variations in temperature, day length and sunlight, which impact forage availability and quality. It has been known from a while already that the fluctuations in forage quality along the year do happen markedly. Crude protein (**CP**) and neutral detergent fiber (**NDF**) contents and organic matter (**OM**) digestibility change markedly from season to season. Taking into account that around 80% of the pastureland in Brazil is covered by C4 grasses of the *Brachiaria/Urochloa* and *Panicum* genera (both of them originally from Africa), one might expect poor cattle performance during the dry season if no supplementation program is considered and implemented. Protein levels in the grass drops to around 4 to 6% in the dry season. The limited CP availability has been recognized as the critical threshold for adequate microbial growth on the fibrous carbohydrates in basal forage which results in decreased intake and animal performance (Detmann et al., 2014). Under these circumstances, the supplementation with nitrogenous compounds is the primary nutritional tool to improve the utilization of low quality forage by grazing cattle.

In a recent meta-analysis on protein supplementation of cattle grazing tropical pastures, Detmann et al. (2014) showed that the maximum digestible OM intake would be obtained with a ruminal ammonia nitrogen concentration close to 13 mg/Dl. Low CP

forages (< 7 %) show a marked increase in intake to a protein meal supplement up to a supplement level of 5 g/kg of body weight (**BW**) per day (Poppi et al., 2018), allowing the animal to deal better with a deficient N situation. Based on this concept, most of the beef industry in Brazil adopts a protein supplementation strategy to the cow herd during the dry season.

For any supplementation program to be effective we need to take into account the forage quality / availability, the feed resources availability / price and the animal production level expected. There is a quite wide availability of different protein feedstuffs in the country, mainly from the soybean and cotton industry, i.e., soybean meal, soy hulls, cottonseed cake, cottonseed meal, whole cottonseed. The corn-based ethanol industry has expanded remarkably in the last few years, mainly in the states of Mato Grosso and Goiás, making ethanol by products such as wet and dry distiller' grains (**WDG** and **DDG**) available to producers.

Although protein byproducts are available, urea is by far the main nitrogen source used in supplementation programs for beef cows during the dry season. Most producers use a urea-salt based products to supplement cows during the dry season, and these products contain non-protein nitrogen varying from 28.2 to 56.4%, according to the severity of the dry season and forage quality. Urea and salt are used as intake limiters and in most situations, and the supplement is provided two to three 3 times a week. The target intake is around 40 to 50 g/kg of cow BW. Thus, for a cow with average BW of 440 kg (~ 970 lb), the supplement intake would be around 180 to 200 g/day (0.40 to 0.45 lb/d). Under this level of intake and considering the limitation of protein that the supplement is intended to alleviate, most producers would expect the cows to maintain body condition score during the dry season. Obviously, the availability of stockpiled forage is critical for the success of this supplementation program and we have used a target to try to provide ideally 4 to 5% of the cow's BW of potentially digestible dry matter coming from pasture. The main idea is to allow optimal utilization of energy from forage fiber, which will be reached by increasing the microbial utilization of potentially degradable fraction of NDF, that represents 60 to 70 % of tropical forages dry matter (Sampaio et al., 2009).

Recently, some producers are evaluating different supplementation strategies for pregnant cows in order to obtain a calf with better growth potential. Fetal programming has been a hot topic in the Brazilian beef industry in the last 3 to 4 years and more and more cattle ranchers are considering using this concept to produce more kg of calf weaned per cow exposed. One of the concerns by cattle producers relative to using strategies to influence fetal programming itself is the cost-benefit of such management strategies. A question often posed is: Does supplementation of cows during mid to late gestation with larger amounts of supplements pay off? Beyond better reproduction status, will such strategies result in a heavier calf all the way from weaning to the rail that pays the additional supplementation costs? What we have seen in the industry is an adoption of more intensive supplementation programs for heifers and primiparous cows, with protein supplementation levels up to 0.2 to 0.3% of their BW during the dry season. Data from Marquez et al. (2017) revealed that maternal supplementation (1 to

1.5 kg of a 28.3% CP supplement) during mid-gestation in Nellore cows grazing low quality tropical pastures increased the number of myofibers in skeletal muscle of the offspring when compared with calves born from dams that were not supplemented during gestation.

The response of beef cows to supplementation with the goal of having heavier calves at weaning depends on a number of factors, including when supplementation takes place (mid vs. late gestation), the nutritional challenge the cow is facing (forage quality and availability), the duration of the breeding season, and the level of supplementation that is dictated by costs. With the growing adoption of TAI in the last decade, it was possible to concentrate pregnancy in the first 21 days of the breeding season. In 2002, only 5.8% of the beef cows in Brazil were artificially inseminated, being only 1% under a TAI protocol, whereas in 2019, 13.1% of beef cow herd received AI with 86% of them under a TAI protocol (Baruselli et al., 2019). Under those management conditions, the cows bred early in the season, will encounter low quality forage only in the final stages of gestation. Conversely, the cows that are bred in the middle and end of a 90 to 120 days breeding season will face nutritional challenges all the way from mid to late gestation.

Therefore, the dietary model must vary according to each ranch reality and objective. Results from Marquez et al. (2017) indicate that supplementation at late gestation may not substantially contribute to increase myogenesis in fetal skeletal muscle. On the other hand, supplementation at mid-gestation may be more effective to increase the commitment of mesenchymal stem cells into myogenesis as well the proliferation of myogenic cells, allowing the formation of more secondary muscle fibers, leading to a greater number of myofibers at birth.

Recent research, on the other hand, has shown that energy restriction during late pregnancy may trigger a more pronounced stress response in the offspring that may impair the muscle tissue and immune system development (Sanglard et al. 2018). Low protein intake under grazing conditions in the tropics during the dry season lead to energy restriction due to low intake, poor diet digestibility, an, as a consequence, low volatile fatty acids production in the rumen. Thus, the dietary strategy needs of the beef cow herd has to be flexible enough to accommodate the variations on breeding season length and the distribution of pregnancy throughout the breeding season. Research on fetal programming in Brazil, with Nellore cows grazing tropical grasses, has shown positive results of implementing a better dietary strategy to the cow herd. Lopes et al. (2019) concluded that protein supplementation for grazing late pregnant beef cows changed the profile of plasma circulating amino acids and synthesis of skeletal muscle tissue in the offspring. Gomes et al. (2018) showed a 14 kg difference in calves weaned from Zebu cows supplemented during mid gestation compared to control counterparts.

During the rainy season, in most situations, there is plenty of rain and moisture in the soil to support forage growth. Along with that, good pasture management allows the production of high quality forage, which in turn maximizes the production of kg of calves weaned per hectare. However, soils that support the vast Cerrado vegetation (also known as Brazilian savanna that concentrates great part of the beef herd) in Brazil can

correctly be considered as some of the most chemically infertile in the word. These soils in the Brazilian tropical regions have high concentrations of aluminum, low pH, and low concentration of Ca, P and the majority of trace minerals, especially those important for animal nutrition. Such conditions result in deficiencies of most necessary minerals in native plants and even on cultivated pastures needed by beef cows and calves. As a result, without a correct mineral supplementation program, poor animal performance would be expected.

There is a vast and broad body of literature supporting the role of trace minerals in proper physiological function, including reproduction. There is an argument, though, about the reproduction response to organic vs inorganic minerals. Recently, Dantas et al. (2019) concluded that the complete replacement or inorganic with a complexed source of trace minerals might be necessary in order to achieve reproductive benefit. It is important to note that under most Brazilian beef cow production scenario, providing mineral supplement consistently can be a challenge. Vast extensive areas, large herds, lack of labor, heavy rain, mud, among other factor, make it complicated to provide minerals frequently and achieve a consistent mineral intake. As a result, weatherized minerals have become a reality in Brazil in the last couple of years. Few animal nutrition companies have used different weatherization technologies, with the same claim: proper mineral supplement intake during the rainy season, when the cows are bred and need the macro and trace minerals the most; and the capacity to provide the minerals more infrequently (for instance, once a week). Brummer et al. (2019) suggested that newer forms of mineral delivery such as organically based and chelated minerals for beef cattle may provide additional long-term supplementation effect. Thus, combining weatherized technology with organic or chelated minerals seems to make sense during the rainy season. We have seen consistent intake and better performance of beef cows supplemented with this type of product and following a standard procedure when it comes to frequency of mineral provision in challenging environment such as in Pantanal and in the border of the Amazon.

The main nutritional approach used during the rainy season for beef cows under grazing in Brazil is to provide a mineral supplement aiming at an intake around 25 g/100 kg of BW, which would allow the provision of 8 to 9 g of P/cow/day and most of the key trace minerals such as Zn, Cu, Mn, Co, I, and Se. In most situations, the trace minerals intake from grass is not taken into account when formulating the mineral supplement, and most animal nutrition companies would consider the mineral requirements determined either by Nasem (2016), by BR CORTE (2016) or a combination of both to establish the concentration of trace minerals in the supplement. It has been recommended to feed around 120 to 130% of trace minerals in free-choice minerals year round, thereby ignoring the amount being supplied from pasture. Even though it is well established that a proper level and balance of minerals and vitamins are essential to the health, growth and reproduction of beef cows (Rasby et al., 1998), most free-choice minerals would be devoid of vitamins when used during the rainy season. Vitamins are in substantial concentration in green, leafy forages. Therefore, most forages during the rainy season will meet cow requirements for fat-soluble vitamins.

Another technology that has been used in fee-choice minerals for beef cows is incorporation of ionophores. These compounds have been used for a long time in other countries. Mature beef cattle grazing medium to high quality forages have been observed to have increased weight gain and feed efficiency when provided an ionophore supplemented compared with nonsupplemented control cows (Sprott et al., 1988). Webb et al. (2001) concluded that the addition of lasalocid to the diet would be beneficial in improving postpartum reproductive performance in Brahman cows. One concern that most producers have when feeding an ionophore in the free-choice mineral is related to is impact on supplement intake. Some studies have proven that mineral intake decreases with monensin addition (Beck et al., 2014; Maciel et al., 2019). Due to this effect, lasalocid has been the ionophore of choice for beef cows under grazing and usually supplemented incorporated with free-choice minerals. The main reason to utilize ionophores is to promote an increase in propionate synthesis in the rumen and, consequently increase supply of gluconeogenic substrate for glucose synthesis. A range cow must synthesize nearly all her glucose needs through gluconeogenesis, and tropical forage provides few precursors from which she can produce glucose. Most rumen fermentation in grazing cattle leads to acetate production and limited propionate. Glucose requirements increase with the onset of lactation and glucose is used first for milk production, which can create a deficit of glucose for other metabolic needs. Thus, in order to improve the glucose status of a cow, she must be fed a product that can promote increased glucose synthesis (Petersen et al., 2010).

The nutritional flushing prior to ovarian super stimulation may increase follicular population and super ovulatory response in cows, which may be associated with increased insulin and insulin-like growth factor-I concentrations in response to increased propionate concentrations in the rumen (Sartori et al., 2013). Thus, mineral supplements designed to beef cows in Brazil used during the rainy season and before the onset of the breeding season usually contain lasalocid. Furthermore, these supplements also contain chromium, as chromium alters glucose metabolism and elicit improvements in body condition and reproduction in beef cows (Stahlhut et al., 2006). A final detail on the dietary strategy for cows during the rainy season is the strategy used to change the sodium level in the supplement with the objective to attain consumption of the mineral supplement. When supplements include ionophores, the aimed level of intake is of 50 g/100 kg of BW, which is double the amount of regular free-choice mineral supplement. The reason for that is to try to guarantee the daily dose of the additive and the minerals, increasing the opportunity for improved reproductive performance.

Conclusions

The Brazilian beef cattle industry has evolved markedly in the last decade and the high demand in both domestic and international markets for beef has allowed the adoption of more technology in the different production systems. The cow-calf sector has become the bottle neck of beef production in the country. The technology implementation across the beef production chain has not been evenly balanced, as the feedlot and stocker industry are early adopters compared with the cow-calf. So, there is

a need for research and extension forces to support the cow-calf sector to advance and produce more kg of calves weaned per hectare, and calves with better muscle growth potential. Implemented strategically, technology can be used to improve beef operations across the board for a more integrated approach that saves time, improves processes and leads to increased profitability. The Brazilian beef industry, in particular the beef-cow herd is expected to experience, in the short term, a large increase in technology adoption that will improve productivity.

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SESSION NOTES