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REPRODUCTION OF BEEF COWS: A DETERMINING FACTOR IN PRODUCTION

REPRODUÇÃO DE VACAS DE CORTE: UM FATOR DETERMINANTE NA PRODUÇÃO

REPRODUCCIÓN DE VACAS DE CARNE: UN FACTOR DETERMINANTE EN LA PRODUCCIÓN

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Jaqueline Aparecida Sousa Pereira[1], Fátima Christina França Alexandrowitsch[2], Hoxana Lopes Kattah[3], Bruna Capitaneo[4], Maraiza Rezende Almeida[5], Fábio Nogueira Reis[6], Vinicius José Moreira Nogueira[7], Elizangela Guedes[8]

ABSTRACT

Reflecting a strong participation in the national market, Brazilian beef cattle farming strengthens and enhances Brazil's GDP each year. Considering the high demand for meat and its by-products, reproduction tends to evolve and improve so that results become faster and more profitable. Therefore, technical knowledge about management methods and the essential elements for their implementation becomes indispensable. In this way, the objective was to compile essential and influential information for the production of new animals resulting from reproductive methods applied to cow management. Through a literature review, a collection of essential information on the subject was made, aiming to objectively and clearly demonstrate the stages of the beef cow's reproductive cycle and the key factors leading to excellent productive results.

Keywords: Body Condition. Fertility. Management. Nutrition. Livestock.

RESUMO

Retratando grande participação no mercado nacional, a pecuária de corte brasileira fortalece e engrandece anualmente o PIB do Brasil. Levando em consideração a grande demanda acerca de carne e seus derivados, a reprodução tende a se transformar e ser aprimorada

[1] Master's student in Animal Health and Collective. Universidade Federal de Lavras (UFLA).
E-mail:jaqueline.pereira2@estudante.ufla.br
[2] Undergraduate student in Veterinary Medicine. Universidade Federal de Lavras (UFLA).
E-mail: fatima.alexandrowitsch@estudante.ufla.br
[3] Master's student in Animal Health and Collective Health. Universidade Federal de Lavras (UFLA)
[4] Veterinarian. Centro Universitário do Sul de Minas (UNIS). E-mail: brunacapitaneo21@gmail.com
[5] Veterinarian. Centro Universitário do Sul de Minas (UNIS).
[6] Undergraduate student in Veterinary Medicine. Universidade Federal de Lavras (UFLA).
E-mail: fabio.n.r210@gmail.com
[7] Master's degree in veterinary sciences. Universidade Federal de Lavras (UFLA).
E-mail: vnogueira86@gmail.com
[8] Professor. Centro Universitário do Sul de Minas (UNIS).
E-mail: elizangela.guedes@unifenas.br

para que seus resultados sejam mais rápidos e lucrativos, sendo assim a necessidade do conhecimento técnico sobre os métodos de manejos e elementos essências de implementação se torna imprescindível. Deste modo, objetivou-se o respaldo de informações essenciais e de influência final para a produção de novos animais, resultantes de métodos reprodutivos implementados no manejo de vacas. Através de uma revisão bibliográfica foi feito um agrupado de informações essências acerca do assunto, que tendem a demonstrar de forma objetiva e clara, as etapas do ciclo reprodutivo da vaca de corte e os fatores culminantes para resultados produtivos de excelência.

Palavras-chave: Escore Corporal. Fertilidade. Manejo. Nutrição. Pecuária.

RESUMEN

Reflejando una gran participación en el mercado nacional, la ganadería de carne brasileña fortalece y engrandece anualmente el PIB de Brasil. Teniendo en cuenta la gran demanda de carne y sus derivados, la reproducción tiende a transformarse y perfeccionarse para que sus resultados sean más rápidos y rentables. Por lo tanto, el conocimiento técnico sobre los métodos de manejo y los elementos esenciales para su implementación se vuelve imprescindible. De este modo, se tuvo como objetivo reunir información esencial y de influencia directa en la producción de nuevos animales, resultantes de métodos reproductivos aplicados al manejo de vacas. A través de una revisión bibliográfica se realizó una recopilación de información esencial sobre el tema, que busca demostrar de manera objetiva y clara las etapas del ciclo reproductivo de la vaca de carne y los factores determinantes para obtener resultados productivos de excelencia.

Palabras clave: Condición Corporal. Fertilidad. Manejo. Nutrición. Ganadería.

1 INTRODUCTION

Agribusiness is an important source of income and movement of the Brazilian economy, where beef cattle is inserted and participates in a large portion of the profitability of this market, having in recent years a notorious growth that has allowed the country to conquer one of the largest commercial herds in the world, supplying domestic demand and participating in an important way in Brazil's exports (MEZES et al., 2020).

According to the last agricultural census carried out in 2017 by the IBGE, Brazil predominates the extensive raising of beef cattle, holding more than 170 million head raised in more than 2.5 million properties, where the GDP comprised about 31% of the total agribusiness, reaching in the total exports made by the country that year, a share of 3.2% in meat alone.

The Brazilian beef cattle breed predominates, in about 80%, being 90% Nellore or crosses of this breed with taurine (GUIMARÃES AND FARIA 2010), aiming at genetic improvement to enable factors such as greater sexual precocity, docility and better carcass finishing, but maintaining favorable zebu characteristics such as rusticity, resistance to parasites, size, excellence in feed conversion, among others (ARTMANN et al., 2014).

In view of the demands, requested not only for large-scale production, but also for a quality and profitable product for the producer, there is a need for technological investments, qualified labor and economy throughout the process, avoiding losses as much as possible, so that it is possible to achieve the objective of all production, which is reproductive and productive efficiency on properties (BARCELLOS et al., 2016).

According to Pires et al., (2015), reproductive efficiency in production systems is considered one of the most relevant stages, since it is desired to grow and improve the zootechnical indices of the properties so that it is possible to replace the animals without the need for purchase. In beef cattle farming, efficiency in reproduction is aimed at always aiming at calving intervals of 12 months, which would make it possible to obtain 1 calf/year/cow, thus allowing the greatest productive exploitation, where the animal will reach slaughter in the shortest possible time, providing greater profitability to the producer (CASTRO et al., 2018).

There are several factors that directly influence the reproduction of cattle, which is closely linked to productivity in beef cattle, given the need for replacement constant to maintain the level of production buy-sell for the final product. Among the various influencing aspects, sexual precocity, animal fertility, estrus visualization, reproductive and nutritional management, and body condition can be observed (FREITAS, 2021).

Based on the assumption, the present work aimed to guide the reproduction of beef cattle and what influences their efficiency, which is of paramount importance for production

systems, proving to be one of the precursors of productive infallibility and consequently the financial success of the producer.

2 LITERATURE REVIEW

2.1 REPRODUCTIVE PHYSIOLOGY

In the reproductive physiology of bovine females, the endocrine glands involved are the hypothalamus, pituitary gland, and gonads (ovaries). The hypothalamus secretes gonadotropin regulatory hormones (GnRH) to the adenohypophysis through the pituitary portal system, as well as oxytocin to the neurohypophysis, through the neural rod. The pituitary gland, on the other hand, secretes gonadotropin, follicle stimulating hormone (FSH), luteinizing hormone (LH) and prolactin after being stimulated by GnRH. The gonads (ovaries) participate in the secretion of steroid and protein hormones, also helping in the production of oocytes (PANSANI; BELTRAN, 2009).

2.2 FOLLICULAR DEVELOPMENT OF BOVINE FEMALES

The follicle is a morphofunctional unit of the ovary, it is characterized as a very organized structure and basically constituted by oocytes, with the main function of providing an ideal environment for growth, oocyte maturation and hormone production (SANTOS et.al., 2012). Some studies have shown that metabolic hormones, such as growth hormone (GH), insulin, insulin-like growth factor, and leptin are mediators of the effects of energy balance on ovarian development. In addition, the hormones insulin-like growth factor 1 (IGF-I) and insulin play an important role in follicular growth, in which it helps to stimulate mitogenesis and steroidogenesis, due to the induction of LH from thecal cells (RABASSA, 2007).

Follicular development is carried out through follicular waves. Each wave of follicular growth is characterized by a group of small follicles, in which they are recruited and begin the common growth phase for approximately three days. After this process, only one will continue its development, which is called the dominant follicle, and the others undergo a decrease in size, called subordinate follicles (BARUCELLI; GALLAGHER; SALES, 2007). The dominant follicle becomes anovulatory, beginning the process of atresia, where it loses its dominance and initiates a new wave of follicular growth (PANSANI; BELTRAN, 2009).

2.3 ESTROUS CYCLE OF BOVINE FEMALES

The physiology of the estrous cycle is complex and depends on the interaction between the central nervous system, endocrine system, and genitals. The hypothalamus is responsible for the secretion of gonadotropin-regulating hormones (GnRH), released in a

pulsatile manner, binding to pituitary receptors. Then, there is the synthesis and release of glycoprotein hormones, called follicle stimulating hormone (FSH), which is secreted by the anterior lobe of the pituitary gland, promoting follicular growth and hyperplasia in the cells of the granulosa and internal theca in the ovaries, and luteinizing hormone (LH), which induces follicular maturation and ovulation, producing estrogens by the internal theca and luteinization of this and granulosa with the development of the corpus luteum (SANTOS et al., 2012).

The estrous cycle of cows consists of four phases, which are proestrus, which is when follicular maturation occurs; estrus, marked by the manifestation of heat; metaestrus, marked by ovulation and formation of the corpus luteum and diestrus, marked by the activity of the corpus luteum and secretion of P4 (PANSANI, 2009), which is the hormone responsible for inhibiting the release of GnRH, preparing the endometrium for implantation and maintenance of pregnancy (FERREIRA, 2010).

Proestrus lasts around two to three days, and is characterized by a deficit of progesterone and an increase in serum estradiol. This happens due to follicular development, by the release of GnRH and consequently gonadotropins, accompanied by lysis of the corpus luteum. Clinically, the animal has a slightly swollen vulva, a reddish vestibule and low mucus secretion. With rectal palpation it is possible to identify the uterus with good contractility, ovaries with follicles of 15 to 20mm in diameter and firm corpus luteum and in regression with 10 to 20mm (SOARES, 2019).

Estrus is called day zero of the estrous cycle, lasting around 12 to 24 hours in the cow, varying between breeds, in which it begins in synchrony with the LH peak, resulting in two independent phenomena, namely the luteinization of granulosa and theca cells, and the rupture of the ovulatory follicle. Soon after, ovulation occurs and later the formation of the corpus luteum (SANTOS; et. al., 2012). In the ovary, this period of the estrous cycle is characterized by high secretion of estrogen (E2) from the pre-ovulatory follicles (PANSANI, 2009).

Metaestrus is the phase where ovulation occurs and lasts from ovulation until the fifth day of the estrous cycle. It can also be considered a progesteronic phase, since the formation of the corpus luteum and production of progesterone begins, in addition to estrogen (E2) beginning to fall. At the time of ovulation, the preovulatory hypothalamic center releases a high amount of GnRH, stimulating the pituitary gland to release a spike of LH (MABA, 2018).

Diestrus is the longest phase of the cow's cycle, lasting between 10 and 14 days, and is characterized by the intense activity of the corpus luteum, which secretes a high concentration of progesterone (SOARES, 2019). In this phase, the corpus luteum still develops, reaching the maximum of its growth and production of progesterone, in which it

causes the gonadotrophic wave not to complete its maturation of follicles, due to the follicular growth after ovulation, resulting in their atresia. Clinically, it is possible to analyze uterus with relaxed muscles, endometrium expression with hypertrophied glands, closed cervix with dense and viscous mucus, vagina with pale and dry mucous membranes (SANTOS et al., 2012).

2 HEAT DETECTION

The high concentrations of estrogen in the estrus period sensitize the central nervous system, leading the female to manifest sexual behavior. The most characteristic behavior at the beginning of this phase is the acceptance of the mount by other females or by the male, resulting from the occurrence of the pre-ovulatory LH peak (TRIANA, 2012).

It is common to present other signs of estrus such as: restlessness, passivity in the presence of the male, abundant and crystalline elastic vaginal secretion, swollen vulva, urine with frequency, reduction in food intake and/or milk production, insertion of the goosebump cause, hyperemic vaginal mucosa, etc. (DA SILVA, 2020).

In this sense, performing heat detection efficiently is one of the factors that directly interferes with the gestation rate, reduces production during the animals' lifespan, and prolongs the interval between calving (PEIXOTO, 2013).

These interferences occur mainly in properties that make use of artificial insemination (AI), as the female must be detected in heat before insemination. The increased detection rate will result in a higher net cow/year return, and sooner the cow will conceive again. Thus, to detect the female in estrus, it is necessary to observe the signs, and the time and time spent per day are of paramount importance in the efficiency of this detection. (DA SILVA, 2020).

It is recommended to observe them 3 to 4 times a day, for periods of approximately 45 minutes, in order to detect a good percentage of females accepting mounting. It is also important to include observations at night, as many cows have greater sexual activity between 6 pm on one day and 6 am on the other day (TRIANA, 2012).

3 PUBERTY AND MATURITY IN BEEF COWS

Puberty can be defined as a period of transition between the immaturity of the postnatal period and sexual maturity that culminates in the acquisition of reproductive capacity, allowing the generation of offspring (FILHO, 2008).

In heifers, puberty can be defined as the time when the first ovulation occurs, from that moment on, the female acquires the ability to reproduce. However, puberty should not be

interpreted as an isolated event, being characterized as the final stage of numerous physiological and morphological changes that culminate in the ability to conceive and maintain pregnancy. Therefore, the heifer's sexual maturity is acquired after ovulation accompanied by an estrous cycle of normal duration and the proper development of the genital system. (NOGUEIRA, 2006).

According to Nogueira (2003), the age of first ovulation is the main determinant of the reproductive life period of cows raised for beef. In taurine heifers, puberty occurs between 7-12 months and 250-300kg of body weight, while the first mating will only happen at 15 months, with calving estimated at 24-36 months of age. In the Zebu the Puberty will happen at an older age and with a higher percentage of adult weight. The average age of first calving in Nellore is, on average, 3.6 years. In general, Zebu heifers reach puberty later than taurine heifers.

Sexual maturity is established immediately after puberty, occurring at different periods of puberty, usually between 16 and 20 weeks after puberty (DA SILVA, 2021). Research has shown that age to puberty is positively correlated with the weight of animals, so nutritional management should be focused on factors that stimulate it, as this is an important productive trait. Therefore, females will only be able to reproduce either by natural breeding or artificial insemination when they reach about 70% of the live weight of an adult animal. (SARMENTO, 2003)

Several environmental factors, such as management, nutrition, sanitary management, climatic characteristics, markedly influence age at puberty. Age at calving, breed, maternal ability and breed of the father are other factors that are directly related to age at puberty, both in males and females, a fact that makes it important to choose the father and mother in the definition of mating, so that early fathers give rise to early offspring (PEDROSA et al., 2010).

4 BODY CONDITION OF BEEF COWS IN THE REPRODUCTIVE PHASE

The objective of beef cattle in Brazil is to obtain one calf/cow/year, and that later the calf obtains an adequate weight for weaning, according to the expectations of the property. The goal within this system is always the improvement of reproductive efficiency, which is a limiting factor for production, as it is related to the period of service, the interval between calvings. Thus, an increase in the duration of these periods will result in a lower number of offspring during the reproductive life of the sow, and consequently economic losses (COZER, 2020).

It is known that within a beef system all phases are of great importance, but the breeding phase requires a differentiated care, as it does not refer only to the calves, but also

to the sows, that is, the heifers able to start their reproductive life and the cows in reproduction. Therefore, the feeding of animals in reproduction needs to be established according to the nutritional requirement of this phase, to keep them healthy and maximize reproductive indexes, and an unbalanced and inefficient diet will impair the entire reproductive management (JÚNIOR et al., 2015).

During pregnancy, the requirement for fetal growth is minimal until 135 days, but when it exceeds this period and reaches the sixth month, the condition becomes different, as it is the period in which there is a greater body increase of the fetus, and the requirements gradually increase as the date of delivery approaches (PEDROSA et al., 2010).

For first-calf heifers in the final third of gestation, the requirement is 66% more phosphorus and calcium than in the initial third. However, protein and energy requirements also increase, being 55% more for energy and 43% for protein. The requirements of this category are higher than those of adult cows, because after calving they still need to finish their growth and development (DA SILVA, 2021). If the diet does not meet the demands for its metabolic activity and maintenance of pregnancy, fetal development may be compromised, weak calves with low weaning weight may be produced depending on the degree of deficiency and type. In this way, the cow will also begin to displace its body reserves to generate the energy it needs, and this is harmful, in view of its future conception and next gestation (LOKER, 2012).

In the lactation phase, cows need extra energy reserves to reestablish reproductive activity and recover from the stress of calving, in addition to producing milk for the calf. This is the most critical phase and requires greater nutritional requirements until the peak of lactation. During this period, they can enter into a negative energy balance, often the nutritional contribution of the diet being lower than their metabolic requirements, and they can lose weight, and lower their score. Therefore, cows must be in good body condition at calving (MICHAEL, 2019).

Therefore, to provide profitability to the producer, and achieve good reproductive indexes, a good nutritional status of the cow during the breeding season period is essential (MENEGHETTI, 2008). According to Loker (2012), pre- and post-calving nutrition is one of the main pillars that support reproductive efficiency, and periods of prolonged anestrus are interconnected with the cow's condition at calving. Thus, the evaluation of the body condition score is a subjective evaluation tool that helps the producer to detect changes in the cow's body composition. The body condition score of sows for cutting ranges from 1 to 9 (Table 1) and for the evaluation it is necessary to observe 3 fundamental points: fat coverage, bone structure, and muscularity (JUNIOR et al., 2015).

Table 1

Body condition score for beef cows

SCORE	ANIMAL APPEARANCE
1	Cachectic – Very debilitated animals, with the bone structure of a palette, ribs, ileum and ischium pointed and well visible. Almost no sign of fat or muscle deposits.
2	Very thin – Observable thinness, but weakness does not occur as in the case of animals with a score of 1. Small evidence of fat deposit, but some musculature is seen in the forelimbs. The transverse and spinous processes are visible and pointed to the touch, with space between them.
3	Lean – Low presence of fat on the loin and anterior ribs. The backbone is still quite visible. Prickly processes can be palpable and still visible. Spaces between less pronounced processes
4	Borderline – Anterior ribs not visible to the eye, last two ribs reveal small visibility, transverse processes identifiable only by light palpation, rounded and not pointed. Rectilinear posterior musculature
5	Moderate – Last ribs not visible to the eye, unless the animal is fasting for a long time, transverse processes also not visible to the eye, but only with firm palpation. There is a moderate presence of fat deposition at the tail insertion.
6	Good – Ribs fully covered and not visible at all. Posterior convex and full. Fat deposits felt on palpation on both sides of the

Source adapted from Fernandes, 2012.

Lean or overly fat cows are harmful to the herd, and the ideal average score recommended for calving is 5 to 6, that is, moderate to good condition on a scale of 1 to 9.

Scores above 7 are considered a waste of energy, expensive to maintain in the herd due to their nutritional requirements, have reduced conception rates, are more prone to the occurrence of dystocic calving and cycling failures. Scores below 5 can lead to ineffective calves, prolonged service period, long interval between calvings, failure to conceive and cycle (FERNANDES, 2012).

Strategically, it is recommended that the evaluation of the body condition score take place at the time of weaning and in heifers and multiparous in the final third of gestation, so that action can be taken to recover the body condition of animals that are in an inadequate situation, and scores below 5 and above 7 should be corrected to present moderate to good condition at calving (NOGUEIRA et al., 2015). This is based on the criterion that if the animal reaches calving in poor body condition and still loses weight due to the negative energy balance, the recovery of its reproductive conditions becomes impaired, causing anestrus prolonged postpartum, and will not be suitable for the beginning of the breeding season, compromising its reproductive indices (FERREIRA et al., 2013).

It is also necessary to emphasize that correcting the body score in the postpartum period is deeply difficult, as it is a delicate moment of great metabolic activity and nutritional needs, and making it gain weight becomes a very complicated task and still with a high financial cost. Therefore, the ideal is to make nutritional corrections in the pre-calving period (MICHAEL, 2019).

5 INFLUENCE OF ENERGY INTAKE ON BEEF CATTLE REPRODUCTION

The animal organism undergoes changes caused by energy from food, where it promotes metabolic and endocrine changes that may end in alterations in ovarian activity, directly interfering with puberty and gametogenesis (CARAVIELLO et al., 2006). When compared to the primary needs of the animal organism, cyclicity and gestational initiation become less relevant, where it will be mobilized only after the supply of what is considered primordial to life (COZER et al., 2020).

The productive and reproductive capacity of the animal is closely linked to the metabolic pathways, which are not yet fully clarified, however, it is known that they respond mainly according to the animal's nutrition, acting basically in the hypothalamus, where they will affect the secretion of gonadotropin-releasing hormone (GnRH), which is the precursor of the synthesis and secretion of FSH and LH, in addition to acting in the control of follicular growth and production of other steroids (PARRA, 2008).

It is known that, in males, thermoregulation is of paramount importance for sperm viability, with the ideal temperature being 2 to 6° C below body temperature, where the

accumulation of fat in the testicles due to heat retention becomes a deleterious factor to seminal quality (FERNANDE, 2018).

When related to females, nutrition is linked to good reproductive performance due to its influence on the hormonal rates traveled in the body, the number of follicles and corpora lutea, as well as the quality of oocytes and embryos, directly affecting the animal's fertility (COZER et al., 2020). During the gestational period, the corpus luteum and the placenta induce an increase in the levels of progesterone in the blood, causing the inhibition of the perception of GnRH receptors. Estrus after childbirth due to the return of the LH release and follicular growth will occur earlier when nutrition and energy intake are at adequate levels (PARRA, 2008).

The only energy source used by neurons is glucose, and therefore it is directly linked to the reproduction and secretion of hormones, in view of the neuronal action in the endocrine system, which in turn forms the neuroendocrine complex, a precursor of reproductive physiology by stimulating hormone production (DIAS et al., 2009). In addition, according to Parra (2008), the drop in insulin levels can lead to failure in cyclicity, since this is responsible for the entry of glucose into the ovaries, causing a lack of energy in the cells responsible for stereoidogenesis for the beginning of a new estrous cycle.

Flushing is an advantageous nutritional strategy carried out to promote greater energy intake in the diet, which will lead to an increase in systemic glucose and consequently an increase in insulin, acting in the elimination of nutrients responsible for the manufacture of GnRH, causing an increase in the synthesis of progesterone by the corpus luteum and granulosa cells (FIGUEIRA et al., 2005).

Below is table 2 where it is possible to observe the possible damage, which, among other nutrients, the energy drop can cause when related to reproduction.

Table 2

Damage related to energy loss in the reproduction of beef cows

Parameter	Deficiency	Imbalance
Abortion, stillborn and debilitated calf	Energy, PB, I, Se, Ca, P, Mn, Cu, Vit. A, D, E	
Decreased signs of estrus and anestrus	Energy, PB, P, I, Mn, Co, Vit. The	

Reduction of conception and early embryonic death	Energy, PB, I, Mn, Vit. The	PB/energy
Dystocic births and gestational complications	Energy, Ca	Cation-anion

Source: Adapted from Cozer et al., 2020.

5.1 PROTEIN

Protein in cattle is made up of about 50 to 80% of rumen microbial protein, where it is later absorbed in the small intestine of the animals in the form of an amino acid. This nutrient acts in practically all areas of the animal organism such as growth, metabolic control, enzymatic catalyzing, immune system, control of body development, formation and propagation of nerve impulses, cell differentiation, among others (FRANCO et al., 2016).

When it comes to nutrition, diets with higher protein content have greater palatability, which is directly linked to increased feed consumption by animals. In addition, the protein is closely linked to reproduction, since, in deficiency, it is a precursor of the low development of the uterus and ovaries, as well as one of the causes of a drop in glucose at a hypothalamic level due to the low concentration of insulin in plasma caused by the drop in amino acid levels (COZER et al., 2020). Glucose, essential for the release of LH by the pituitary gland, will only be present at adequate levels if protein consumption is balanced, which shows the close connection of this nutrient in cattle reproduction (SILVA et al., 2016).

On the other hand, according to Franco et al., (2016), the hydrolysis promoted by rumen bacteria or in cases of use as a form of energy, causes the amino group (NH2) of the amino acids to be removed, obtaining a skeleton product of carbon plus ammonia (NH3), which will be used at the ruminal level by the bacteria synthesizing microbial protein. This release of ammonia is quite fast, not allowing the bacteria present to use it fully, causing an accumulation in the animal organism, and in view of its toxicity, the liver converts it into urea, allowing a less toxic storage of nitrogen until its filtration and excretion occur at the renal level or return to the rumen (SILVA et al., 2016). The high levels of urea, even that much of it is metabolized at the hepatic level, can cause changes in the pH of the uterus, PGF2α and progesterone synthesis that will culminate in an unfavorable site for embryonic development, in addition to generating toxicity for sperm and eggs, requiring the correct protein balance in the diet of cattle. (FRANCO et al., 2016).

5.2 FAT

The objective of including fat in the diet, in addition to increasing the animal's energy supply, where it has been shown to be directly linked to metabolic hormones and gluconeogenesis at the hepatic level, stimulating the secretion of hypothalamic GnRH, is to include essential fatty acids (AGEs) in the diet, which can be added to 3% of the total daily diet, and should not be exceeded by 5% by reducing dry matter intake (FERNANDES AND MADUREIRA, 2013).

Lipids are present in several activities of the animal body, not limited to the secondary supply of energy, but are also responsible for assisting in the absorption of vitamins, storing water, making meat softer and tastier when located between the animal's muscle fibers, isolating body temperature, as well as acting on the palatability of food and animal reproduction (GOLÇALVES AND DOMINGUES, 2007).

Omega 6 and omega 3 are lipids that act directly on ovulation, uterine capacitation, progesterone production, sperm quality, immune system, oviduct contractility, and interferon production, acting on the oviduct to recognize the embryo, preventing its expulsion at the time of implantation (CHIANEZE et al., 2020).

Protected fat, by-pass fat, calcium soaps or calcium salts of fatty acids, have received greater focus in recent years, being formed by unsaturated fatty acids and a protein layer that allows greater digestibility by promoting protection when passing through the rumen, in addition to not changing food consumption, increasing energy density without alteration in digestion, being an interesting strategy in the diet of beef cattle because it acts better than other sources of fat that can reduce fiber digestion (MORAIS et al., 2012).

6 POSTPARTUM ANESTRUS IN BEEF COWS

Anestrus is a period that extends from childbirth to the first fertile heat. During this period, uterine involution, elimination of pathogens and regeneration of the endometrium will occur, until the complete restoration of the uterus (EMERICK, 2009). Therefore, after childbirth, a sequence of physical and endocrine changes must occur in the reproductive system so that it returns to its cyclical activity. In order to obtain one calf/cow/year within the herd, this interval cannot exceed 80 to 85 days, taking into account the gestation period of 280 days, but the duration of this interval will depend on several factors (FERREIRA et al., 2013).

Beef cows commonly have longer postpartum anestrus compared to dairy cows, this is due to a sum of 3 factors: low body condition, presence of the calf at the foot and inefficient nutrition. In this sense, the delay in the resumption of ovarian activity in the postpartum period

due to deficient diets is the main cause of failure of the next conception. This will lead to a decrease in the production of calves, and a reduction in their weight at weaning (MICHAEL, 2019).

The negative energy balance reduces the availability of glucose and triggers the mobilization of reserves to maintain metabolic activity, when associated with low levels of energy intake due to the dry season, for example, there will be a compromise in the functioning of the reproductive axes (MEDEIROS, 2015). In general, females will exhibit anestrus when they lose an average of 22% of their initial body weight. In this way, 500kg cows will pause their cyclicity when they lose 110kg, but before that their fertility will already be reduced (EMERICK, 2009).

In the literature, there are several hypotheses to explain the mechanism by which nutrition can affect the reproductive efficiency of the cow. One of them describes that deficient nutrition, by causing prolonged negative energy balance, will cause an increase in the concentration of non-esterified fatty acids, which will reduce the multiplication of granulosa follicular cells. (SARTORI, 2010). Thus, estrogen synthesis will be compromised, leading to a reduction in LH pulses, which is responsible for triggering ovulation, culminating in follicular atresia. As a result, cows with a body score below 5 may have more than 14 follicular waves before ovulation (EMERICK, 2009).

Oliveira et al., (2010) states that for the ovulation of the dominant follicle to occur, there must be approximately 1 pulse per hour of LH, so that the maximum estrogen production. However, after delivery there is a low frequency and amplitude of these pulses. Thus, approximately 1 pulse occurs every 4 hours.

In addition, it is also described that leptin, a hormone secreted by white adipocytes, has a direct influence on the reproductive axis. It regulates the animal's food consumption, body weight and energy balance, and acts on the central nervous system signaling its nutritional status. Bovine theca and granulosa cells have receptors for this protein, and leptin is capable of modulating steroidogenesis (DOS SANTOS., et al 2020)

The mechanism of action of leptin on reproduction is not yet very well elucidated, According to Parra (2008), there are two ways in which leptin acts in the reproduction of females, one being direct, when it promotes the increase in the production of sex hormones, which was evidenced by the increase in uterine size, due to the greater glandular proliferation in the uterine epithelium and endometrium; and indirect, when it acts on the hypothalamic-pituitary axis, emitting information about the nutritional status of the individual, allowing the reproductive process to progress or not if there are sufficient energy reserves.

Cows submitted to a 60-hour fasting period showed a decrease in the plasma concentration of leptin and a 30% decrease in the expression of leptin genes. Thus, it was evidenced that in animals that are in a negative balance, the use of exogenous leptin increases the serum levels of the same hormone, the pulses of GnRH and LH, and consequently the growth of the dominant follicle (FRANCO, 2016). Plasma levels of leptin are also proportional to the mass of adipose tissue present, and thus will decrease with weight loss. Thus, an adequate intake of nutrients results in an increase in the concentrations of fat reserves and consequently leptin (MARQUES, 2014).

7 STRATEGIES TO IMPROVE REPRODUCTIVE EFFICIENCY IN BEEF COWS

The reproductive management of beef cattle contains a set of practices and techniques that must be adopted in order to improve the reproductive efficiency of a herd. This reproductive management should start well before breeding, with a replacement and correct rearing of the sows. It is important that a thorough observation of the herd and its indices is made so that an objective can be set and a decision can be made on which management should be implemented (BAZILIO, 2018).

It is recommended to observe the following zootechnical indexes: percentage of calving and empty cows, development of the calves if they are developing genetically better than the mother and if they are developing within the standard, percentage of gestation with natural breeding and insemination, and if there is an incidence of some diseases or injuries affecting the herd (MARQUES, 2014).

The breeding season is one of the most important decisions for correct reproductive management in beef, in which all artificial mating or insemination is concentrated in a limited period of the year, so that the cows become pregnant, calving, and weaning at the same time. The season should comprise a period of 2 to 4 months for cows, and for heifers the duration may be shorter. (SILVA, 2021). The time in which the breeding season will be used varies according to the climate of each region, and should be determined according to the best time for calves to be born, and the period of greatest nutritional requirement of the sows. Thus, the birth season needs to be established in the period of greatest availability of food, which will be in the rainy season. (FONSECA, 2018).

It is of paramount importance before starting the season, to separate the categories and select matrices within reproductive management. This selection must take into account: nutrition, body condition score and whether the animals are free of diseases, also performing the gynecological examination. This phase should also be based on the genetics of the

animal and the ability it will have to produce, where the heifers in the selection must be at 65% of their total weight at puberty before the breeding season (GONÇALVES, 2022).

The evaluation of the body score of cows is one of the most important pillars to achieve reproductive efficiency, and a well-done body condition score evaluation is necessary to identify and correct cows that are in poor body condition during pregnancy, pre-calving, lactation and beginning of the breeding season (BAZILIO, 2018).

Animals that have a body condition lower than the recommended level are recommended that they be kept in a single separate group, and that differential strategies be adopted for this category (COZER, 2020). In central Brazil, the most viable strategy would be pasture supplementation in the pre-calving period, which coincides with the dry season. Thus, the farm must establish a forecast in its annual planning, with deferred pasture areas, as supplementation is only effective when there is the presence of adequate forage mass (CARVALHO, 2017).

The decision on the strategy to be taken should be based on the condition of the category:

a) To maintain body condition – Salt with urea;
b) To maintain body condition – low consumption – protein supplement;
c) To gain moderately body condition – high consumption – protein-energy supplement;
d) To obtain greater gains in body condition above 4 – semi-confinement feed

These recommendations are not valid if there is no good availability of pastures with forage mass. Alternatives a and b are the cheapest and are also effective in maintaining the weight of animals that are weaned and have scores above 4. In females with a score of 3 or below, a high-consumption protein-energy supplement is indicated, around 0.5% of body weight. To achieve daily weight gains of up to 0.400kg, the semi-confinement ration can be used up to 1% of the live weight (FUNSTON, 2010).

In view of the above, it is up to the owner and the technical responsible to make the calculations to find what weight should be gained by the cows throughout the prepubertal phase, taking into account weaning and the beginning of calving, lasting approximately 120 days (FRANCO, 2016).

FTAI (Fixed Time Artificial Insemination) is a technique widely used within reproductive management that has been bringing great advantages to the herd and the producer, because through it the synchronization of the cow's estrous cycle is made through the use of hormones and the insemination of a large batch of cows at the same time, without the need to detect heat (BAZILIO, 2018). The advantages provided by this technique are numerous, such as

increased weaning weight, reduced slaughter age, genetic improvement of the herd, birth of all offspring at the same time and decreased disease transmission since there is no natural breeding (JUNIOR, 2015).

Bulls also play an important role when using controlled breeding or field mounting, and an adequate bull/cow ratio reduces maintenance costs and better exploits the genetic heritage. This relationship is defined by environmental conditions, the behavioral pattern of the breed. Age, sexual experience, and body condition of the bulls. These must be evaluated andrologically, sanitaryly, and behaviorally before they are introduced into the station. For European bull bulls, the rationalization should be 1:25 to 1:40, and for Zebu bulls 1:30 to 1:80 (BAZILIO, 2018).

Diagnosing pregnancy is essential within reproductive management, and it is necessary to identify the presence of a fetus as soon as possible, because if the cow does not become pregnant, it must be inseminated again. Thus, an intermediate diagnosis should be made at 45 to 60 days at the beginning of the season, and a final diagnosis at the end of the season at 45 days. (AMBROSIO, 2018).

In addition, the control and sanitary management of the herd is indispensable for good reproductive management and must be rigorous, starting from the breeding phase with the cutting and disinfection of the navel, colostrum and all vaccinations, going to the rearing and fattening phase, because through this there will be a reduction in the incidence of diseases, and compliance with the established vaccination schedule is of total importance (FONSECA, 2018).

8 FINAL CONSIDERATIONS

In summary, it is possible to observe the effectiveness of an adequate reproduction, making it necessary that the sow has a body score compatible with the need for adequate energy supply, as well as the correct balance of protein and fat, resulting in a new animal, with ideal conditions for a good development. In addition, it is desired that heifers are more precocious, extending their useful life and raising birth rates. And to obtain animals with these qualities, it is necessary to carry out efficient reproductive management with excellence in management, aiming at quality productive gains and with evident results from both initial and future generations.

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