# Nutrition and Food in the Reproduction of Cattle

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## **ABSTRACT**

At the beginning of the 1980s, a series of very profound changes were initiated in the milk cow nutrition approaches, as a consequence of the highest levels of production per cow that were reached by the productive systems of the northern hemisphere. Nutrition is defined as the series of processes through which an organism acquires and assimilates food to promote its growth and replace worn or damaged tissues. The nutrients are fundamental for the animals to carry out their different productive functions. When we consider the aspects that touch the field of nutrition of ruminants, we understand the importance of this group of animals of zootechnical interest, which are able to process plant components that are not consumed by other mammals, the structural carbohydrates (fiber). Ruminant comes from the word "rumen", which is the largest of the compartments in the stomach of four compartments of a bovine, sheep, or goat. This structure is where microbial fermentation takes place. The ruminants, through evolutionary processes, developed life relationships with microorganisms which enabled them to use fiber as food, that is, they developed in some way their "food factory". They eat the forage to be transformed by the rumen's microbiota into substances that are the source of energy for the animal and for the microbial synthesis, the microbial cells are an excellent source of proteins for the animal. However, the processes that make the ruminal microbiota are, in a certain way, inefficient. Grass degradation produces volatile fatty acids, microbial protein and gases. Within these gases, some are environmental pollutants such as CO2, methane and nitrous oxide. Millions of bacteria, protozoa, and fungi live in the rumen and degrade parts of the plant rich in energy, making them digestible to the animal host. After the forage has been digested in the rumen and degraded to smaller parts, it can pass through the reticulum and omasum, which function as colanders that trap large pieces of material preventing them from reaching the abomasum, or "true stomach", where digestion continues. The nutritional concern for ruminants focuses on energy (ie, carbohydrates), protein, minerals, vitamins, and water. The energy (carbohydrates) is responsible for the functions of growth and maintenance of the animal, and the generation of heat. The protein makes the tissue grow and performs other vital functions. Other nutrients and minerals such as vitamin A and E, calcium, phosphorus, and selenium can be fed to "free choice" as a mineral supplement. Dairy cows of high productive potential (9000-12000 / liters / lactation) currently represent a real challenge for nutrition. For many years, there has been evidence of the impact of nutrition on the reproductive behavior of the bovine female. The main factor that affects reproduction is the undernourishment due to the scarcity and quality of the food. Subsequent research has shown that nutritional effects are exerted through complex interrelations between various aspects such as: content and use of body reserves, distribution of nutrients between different systems and organs and prioritization of the use of nutrients for various functions in addition to reproduction.

**Keywords:** Nutrition, food, ruminants, reproduction.

## I. FOUNDATIONS OF ANIMAL NUTRITION

Animal nutrition is the part of animal husbandry that studies the use of different foods – or, more specifically, the immediate principles that constitute them - to satisfy the Submitted: March 1, 2021 Published: May 07, 2021

ISSN: 2684-1827

**DOI**: 10.24018/ejfood.2021.3.3.184

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needs of animals useful to man [2]. This is defined as the series of processes through which an organism acquires and assimilates food to promote its growth and replace worn or damaged tissues. The nutrients are fundamental for the animals to carry out their different productive functions [13].

Nutrients absorbed from the digestive tract include volatile fatty acids, glucose, minerals, and vitamins. These are used in the synthesis of many different compounds found in meat, milk, and wool, and to replace nutrients used to support living processes including reproduction.

For the purposes of calculating nutrition, they are usually divided into two groups:

Of support: they are those that allow the animals to cover their minimum needs to continue living, although without any type of production [2].

Of production: they are those that, once covered the necessities of support, allow the animals to produce something useful for the man: meat, milk, young, work, etc.

The total food needs are calculated by adding the support and production needs.

The nutritional needs of animals with respect to reproduction are critical, to achieve an adequate level of maintenance. Undernutrition during growth produces delays in sexual maturity. If there are nutrient deficiencies before the mating season, they can render animals sterile, produce low fertility or fail to maintain and establish pregnancy.

On the other hand, nutritional requirements should be taken as basic and fundamental within the diet, taking into account the intake, which is defined as the ingestion of nutrients by the animal, and is regulated by factors that in turn interrelate as [30]:

Palatability, it is the flavor and texture of the food. Ruminants seek sweetness in their food, probably because the sweet taste is an indicator of soluble carbohydrates, the most critical element of the diet for the animal after water. Ruminants avoid bitter flavors, which are usually associated with toxic secondary chemicals [30].

The foraging behavior describes how the animal performs the foraging process. According to Fred Provenza, a pastoralist researcher at UTA State University, the study of foraging behavior involves understanding:

- ♣ Habits of food and habitat preferences, and
- ♣ The effects of nutrients and toxins of preference.

The bite size and the bite rate also influence the intake. The denser a pasture, the more forage the animal can take with each bite. This exemplifies the fact that the relationship between grazing management, animal behavior, and nutrient intake is not a simple relationship. It is a complex and constantly changing relationship that follows changes in seasons, forage quality, and amount of forage [30]. Chemical factors include nutrients, but also secondary chemicals that are usually associated with the defense of the plant. It usually refers to secondary chemicals as toxic substances, but the toxicity depends on the degree, or dosage. All plants contain secondary chemicals to some degree, but animals have evolved an innate sense of what is good to eat [32].

Animals limit the number of plants they consume that secondary chemicals through a feedback mechanism, which results in satiety, or the feeling that they have eaten enough. According to Webster, satiety is the "quality or state of being fed or gratified up to or beyond the capacity point, or the repulsion or disgust caused by overindulgence or excess. "When ruminants consume enough of a certain toxic substance, a feedback mechanism

induces a switch to an alternative source of nutrients. This is the reason why cattle, sheep, and goats graze more (have a higher intake) in a diverse pasture. Variety stimulates their appetite and provides alternative sources when they have reached the limit of their preferred source of food [30].

Quantity, density, and availability of forage, directly influence the intake of forage, and intake is directly related to the density of the meadow. Ruminants can only take a limited number of bites per minute as they graze, and cattle in particular only graze for 8 hours a day. This is why it is important to make sure that each bite taken by the animal is as large as possible. Bovine grazes surrounding the forage with its tongue and then tearing it upwards; sheep and goats use their lips and teeth to select highly nutritious parts of the plant. Large bites of forage are therefore insured by maintaining high density of pastures [30].

The length of the grazing period (the time the animal is in the pasture) also has a direct effect on the intake of grass. The intake of an animal decreases as time increases in the same paddock. This occurs due to [30]:

- 1. The effect of disappearance of the plant (as the plants are grazed) and the subsequent search for plants by cattle [30].
- 2. The decrease of raw forage protein that begins two days after the animals have entered the paddock. Jim Gerrish has shown that as an animal remains in the paddock, the intake and live weight gain decrease. Physiological state refers to the state of life in which the animal is, and the level and type of production in which they are being maintained. The key physiological states in the life of ruminants are the following [31]:
  - ♣Growth (that is, young lambs, kids, and calves, including feeding animals).
  - ♣Late pregnancy (very important in sheep and goats).
  - ♣Breastfeeding (for milk production, maintenance of offspring).
  - ♣ Maintenance (like the dry period of the cows.)

For example, the time of highest ingestion of dairy cows occurs after the time of maximum milk production [20]. Between the highest point of lactation and the intake, the body must resort to reserves to maintain an energy balance. For this reason, milk-producing animals generally lose body condition during this period [6].

Temperature affects the amount of food the animal needs to maintain its bodily functions. The metabolism of an animal increases as the temperature decreases under the comfort zone for the animal. As the temperature decreases, more energy is needed to maintain internal heat, so the intake increases accordingly. In turn, animals are not going to graze in both hot and humid climates [6]. Animal nutrition aims, on the one hand, to study the nutritional value of foods by analyzing the quantity and quality of the immediate principles that constitute them and, on the other, to determine with the greatest possible precision the needs of animals in those principles; all with the idea of planning your diet to obtain maximum benefit. In general, what is intended is to cover, at minimum cost, the essential food needs to guarantee the desired production [2].

The body condition of the growing breeding cow is closely related to its weight gain. This parameter is a good indicator of cow development [12]. In the case of the extensive production of meat, it is usual that the farmer does not intend to satisfy completely and permanently the needs of the cattle; that plays with their body condition, with the increase and decrease of body reserves, to make the most of natural pastoral resources and minimize the need for supplementation, for the same production [2].

## A. Common Methods of Analysis of Nutrients for Cattle

In general, the variables that are considered are the bromatological composition and the cost of the food and the needs of the animals. The amount of each food that each animal ingests in a certain period of time, normally a day, is called a ration [2] bromatological analyzes aim to determine the quantity and quality of the immediate principles that constitute a certain food. As the rigorous determination of the type and quantity of the different immediate principles that constitute a food would be an extremely complex task, usually simpler analytical techniques are used that determine and value not the immediate principles but other similar variables, although easier to extract and quantify, which are called nutritional principles. The most used bromatological analyzes currently follow the schemes of Weende or Van Soest [2].

The scheme of the correspondence between immediate principles and nutritious principles, according to the Weende scheme, is the following:

TABLE I: IMMEDIATE PRINCIPLES AND NUTRITIOUS PRINCIPLE

Immediate	Nutritive	Observations
principle	principle	
Water	Humidity	Moisture 70 °C or 105 °C,
		over fresh weight
Minerals	Ashes	550 °C (oven)
Lipids	Ethereal	Soluble in petroleum ether
	extract	at 40-60 °C
Prótidos	Crude	Kjeldahl (Total N, not only
	protein	protein)
Carbohydrates	Crude fiber	r
•	Crade Hoer	
Other organic	M.E.L.N.	Mat. extractive N.
compounds		

Van Soest tried to refine the imprecise concept of raw fiber by breaking it down into two others: neutral detergent fiber (NDF) and acid-detergent fiber (ADF), with different lignin content and, therefore, different digestibility [2].

For the comparison of the nutritional principles of food with the nutritional needs of animals, the following variables are usually contemplated: dry matter (M.S.), energy, digestible protein, minerals, and vitamins.

As can be understood, the chemical process of a bromatological analysis is long, complex, and expensive. For this reason, in recent decades the technique called NIRS (Near Infra Red System) has been increasingly used, consisting of using near infrared radiation to determine the chemical composition of a substance [2]. In Bromatology, conveniently calibrated with analyzes performed by traditional procedures, in wet, allows to analyze very high numbers of samples in a very short time, with an acceptable precision and a much lower cost [8].

## B. Measurement of the Use of These Nutrients (MS, Energy, Protein, Minerals, and Vitamins)

The ingestion capacity of an animal depends, as is logical, both on the characteristics of the food (especially fiber and energy content) and on the physiological situation of the

animal; for example, energy needs, gestation (size of fetus) or lactation [33]. The capacity of ingestion is determined, for each food, by offering it to the animal so that it consumes it "ad libitum". The differences between ingestion capacity of different types of food, for the same livestock species, are quantified through the so-called Ballast Units (UL). The Ballast Unit is the ingestion capacity corresponding to a good quality grass. The ballast value is the quotient between the quantities that the same animal can ingest from that grass and the food that in each case is considered. If the Ballast Value (VL) is greater than 1, it means that the animal can eat less of that food than of good quality grass; if, on the other hand, it is less than 1, it means that it can eat more [30].

The dry matter of the food contains all the nutrients (except water) required by the cow. Milking cows' diets are based on the amount of dry matter, what is left of the feed once the water is removed, which can be provided to the cows to maintain good health and achieve high production. Therefore, to properly balance the rations it is essential to know the dry matter levels of the ingredients that make up the ration. Forages are the most susceptible to differences or changes in dry matter, and dry matter levels should be measured on a regular basis to ensure that the ration is constant. Dry matter should be measured at least once a week, while in large barns it should be considered to measure the dry matter of the forage daily [8].

In contrast to other nutrients, the energy content in a food can is not quantified by laboratory analysis. The amount of energy in food is measured by experimentation. In the body, carbon (C), hydrogen (H) and oxygen (O) from carbohydrates, lipids and proteins can be converted into H<sub>2</sub>O and CO<sub>2</sub> with the escape of energy. The megacalorie (Mcal) is typically used as a unit of energy, but the joule (J) is the official unit of measure. In dairy cows, energy is expressed as net lactation energy (NLI). This unit represents the antity of energy in the food that is available for the maintenance of body weight and milk production. For example, 0.74 Mcal ENL is required to produce 1kg. of milk and energy in food varies between 0.9 and 2.2 Mcal ENL/kg. dry matter.

The microbial protein is generated from the activity of ruminal microorganisms, which synthesize it using the fermentable energy that is present in the food consumed, together with amino acids and / or non-protein nitrogen, product of the degradation of dietary proteins. It represents the most important protein source for the dairy cow metabolism [4]. The crude protein (PC) is calculated based on the nitrogen content of the forage. The value of PC is important since the protein contributes energy and provides essential amino acids for both the rumen and animal microbes. The greater the protein that comes from the forage, the less amount of supplement is needed [30]. A Danish chemist, J.G. Kieldahl, developed a method in 1883 to determine the amount of nitrogen in a compound. The average content of nitrogen in proteins is 16%. Thus, the percentage of protein in a food is typically calculated as the percentage of nitrogen multiplied by 6.25 (100/16 = 6.25). This measure is called crude protein. The word raw refers to not all the nitrogen in the food is in the form of protein. Normally the figure for raw protein gives an overestimated of the true percentage of protein in a food. Raw protein in forages ranges from 5% (crop residues) to more than 20% (good quality legumes). Byproducts of animal origin are usually very rich in protein (more than 60% crude protein).

It was from 1960 when the revolution in the analytical methodology for the macrominerals took place, being the techniques more used the ones of spectroscopy of atomic absorption, that allows to detect ppm; direct reading emission spectrophotometry, which detects several elements of the same sample; neutron activation analysis; plasma emission spectrophotometry; anodic band voltammetry; mass spectrofotometry by scintillation and X-ray fluorescence. This last improved methodology has been very useful since it has established the essence of some trace elements [11].

The determination of the needs and tolerance of the minerals have been determined by two basic approaches: factorial method (it is composed of two phases, in the first the net quantity deposited in the tissues is calculated during: growth, reproduction, secretion in the milk to those that are added the losses of the element in the organism by maintenance and endogenous losses, the second by metabolism tests determines the percentage of use of the element in question, the net needs are divided by the percentage of use in order to reach the total amount that is needed in the diet) and feeding trials (consists of administering known quantities of the mineral under study and observing the responses and yields of the animals) [11].

As regards the content of vitamins in a food is not determined regularly, but vitamins are essential in small quantities to maintain health, points out that considering the botanical compositional variability and the seasonality present in permanent-type pastures, it is difficult to satisfy the nutritional needs of high production dairy cows only with grazing, because they require very well-balanced diets to satisfy their needs. daily requirements, which are, based on dry matter: 16-18% crude protein, about 35% nonstructural carbohydrates and an energy concentration of approximately 2.8-2.9 Mcal of metabolizable energy per kg of dry matter consumed.

## C. Chemical Composition of the Nutrients Found in Food

Foods contain different amounts of water. In their immature stages the plants contain 70-80% water (i.e., 20-30% dry matter). However, the seeds do not contain more than 8 to 10% water (90 to 92% dry matter).

The nutritional composition of the food is usually expressed as a percentage of dry matter (% DM) instead of the percentage of fresh food ("% offered") given that [8]:

- · The amount of water in the food varies a lot and the nutritional value can be compared more easily when it is expressed based on dry matter.
- · The concentration of nutrients in the food can be directly compared to the concentration required in the diet. The dry matter in a food can be divided into organic and inorganic matter.

The compounds containing carbon (C), hydrogen (H), oxygen (O) and nitrogen (N) are classified as organic. The inorganic or mineral compounds are the other chemical elements (calcium, phosphorus, etc.) [2].

In plants, the mineral content varies between 1 to 12%. Fodder usually contains more minerals than seeds or grains. The by-products of animal origin that contain bones can have up to 30% of minerals (mainly calcium and phosphorus).

Minerals are often classified as macro and micro minerals (Table II).

TABLE II: MACRO AND MICRO MINERALS [10]

Micromineral
Iodo
Iron
Copper
Cobalto
Manganese
Zinc
Selenium

Nitrogen is found in protein and other compounds included in the organic matter of a food. Proteins are made up of one or more chains of amino acids. The proteins are composed of amino acids. There are 20 amino acids, and the genetic code of the animal determines the amino acid sequence of each protein, and this sequence in turn determines a specific function in the organism. Some amino acids are essential, and others are not. Amino acids that are not essential can be synthesized in the body, but essential amino acids must be present in the diet because the body cannot synthesize them [2].

Part of the nitrogen in food is called non-protein nitrogen (NNP) because nitrogen is not part of the structure of a protein. Non-protein nitrogen (e.g., ammonia, urea, aminos, nucleic acids) has no nutritional value for monogastric animals. However, in ruminants, non-protein nitrogen can be used by rumen bacteria to synthesize amino acids and proteins that are beneficial to the cow.

## II. BOVINE DIGESTION

Nutrients absorbed from the digestive tract include volatile fatty acids, glucose, minerals, and vitamins. These are used in the synthesis of many different compounds found in meat, milk, and wool, and to replace nutrients used to support living processes including reproduction [30]. Digestion begins when the animal takes a bite of the pasture. As the animal chews the food it condenses into a bolus - a package of food that can be swallowed. Saliva is excreted, which also helps swallow and serves as a buffer in the stomach. Once in the rumen, the food begins to undergo fermentation, millions of microorganisms digest the food, resulting in final products that serve as a major source of nutrients for the animal. Some main products formed are ammonium, methane, carbon dioxide, and volatile fatty acids (VFAs). AGVs are absorbed and used as an energy source by the animal, ammonium can be absorbed into the animal's system through the ruminal wall or can be consumed by bacteria by bacteria to be converted into microbial protein. This microbial protein is then passed through the digestive system to be absorbed by the small intestine.

Not all the food that the animals consume is really assimilated by their organisms; a certain percentage is eliminated by different mechanisms and, therefore, is not really useful. Therefore, in animal nutrition, the concept of digestibility is handled, which is defined as the capacity of a certain immediate principle to be really assimilated by an animal. A very elementary way of quantifying it is the socalled digestibility coefficient, which is defined as the percentage of a certain immediate principle that, after being consumed by an animal, is not eliminated in the form of faeces [2].

$$D = 100 (P - Ph) / P$$

Where P is the total amount of the immediate principle ingested by the animal and Ph, the amount of said nutritive principle that appears in their feces. In fact, this index only estimates the digestibility of the immediate principle ingested, because the fact of not appearing in the stool does not necessarily imply its assimilation: part can be lost in gaseous form or by means of different secretions [2].

The digestibility can be measured "in vitro", by chemical procedures that try to imitate the digestion process, generally by the Van Soest system, or "in vivo", using a reduced sample of fistulated animals or provided with bags for the collection of stool In the first case, it is a laboratory approach to the actual process of digestion and, in the second case, an estimation through a small number of animals whose behavior is presumably conditioned by human manipulation. In both cases, the measurements are complicated and present important practical limitations [2].

#### A. Nutrient Metabolism

Ruminant comes from the word "rumen", which is the largest of the compartments in the stomach of four compartments of a bovine, sheep, or goat. This structure is the "oven" where the microbial fermentation takes place.

the forage has been digested in the rumen and degraded to smaller parts, it can pass through the reticulum and the omasum, which function as colanders that trap large pieces of material preventing them from reaching the abomasum, or "true stomach", where digestion keep going. From the abomasum onwards, the ruminant digestive system resembles other animal digestive systems with a small and large intestine, colon, and anus [30].

#### B. Water

Cattle require between 3 to 30 gallons of water per day. Factors that affect water intake include age, physiological status, temperature, and body size [30].

The quality of the drinking water is a fundamental factor for the health of the animals and the productive level reached in the livestock systems. The bovine is a species able to adapt to the consumption of different types of water, however, the alterations in the quality produced by an excessive concentration of salts or chemical elements, produce decrease in the production and impact on the health of the cattle, with the consequent economic losses for the producer [27]. The criteria that are usually taken into account for determining the quality of drinking water are its physicochemical and organoleptic characteristics, the presence of toxic compounds, the excess of minerals and the presence of pathogenic bacteria [23]. The mineral composition of water influences not only the intake of water but also of food, thus conditioning the production levels reached. Dairy production is, among the livestock activities, one of those that demand more water, not only for animal

drink, but also for the hygiene of the dairy farm, the milking machine and for the cooling of the milk. Milking animals require a high availability of drinking water of good quality, in relation to body weight, (consumption can exceed 150 L/day) because water represents 87% of the final composition of the milk produced. The dairy cow of high production is the most sensitive to changes in water salinity, tolerating 30-40% less than breeding cows [28].

#### C. Amino Acids

Cattle require two types of protein in their diet. One type is degraded in the rumen and is used to meet the requirements of the microbial population, and the other skips the rumen and is used primarily to meet the animal's nutritional requirements. When the protein is degraded in the rumen, it is called degradable protein in the rumen. The degradable protein in the rumen is essentially food for bacteria present in the rumen. When the microbes die, they pass through the stomach and small intestine where they are digested by the animal. The resulting microbial protein is then absorbed by the animal's bloodstream. Some of the protein present in the diet is not subjected to degradation in the rumen and goes directly to the abomasum or stomach to be digested. When the protein escapes from ruminal degradation and passes into the stomach, it is called a nondegradable protein in the rumen. Ruminants need approximately 65 to 68 percent degradable protein in the rumen, for an adequate rumen function and for the development of microbial protein [30].

## D. Carbohydrates

Some species of bacteria, such as those that live in the rumen of the cow, obtain the energy they need for growth through fermentation (life in the absence of oxygen) [28].

Protozoa and bacteria get the energy they need to grow by converting carbohydrates into glucose, and then fermenting glucose to form methane, carbon dioxide, water, and volatile fatty acids (VFA). The main AGV produced in the rumen are acetic acid (vinegar), propionic acid and butyric acid containing, respectively, 2, 3 and 4 units of carbon. The AGV are the final products of bacterial fermentation and are very important for the nutrition of the cow. The VFAs contain most of the energy that contained the original glucose and are therefore used by cows as their energy source.

## E. Lipids

The lipid metabolism of ruminants is very different from the monogastric in different aspects that are ultimately related to the modifications that the nutrients of the diet, including lipids and lipogenic substrates, suffer from for ruminal microbial fermentation [23]. Fats in food undergo two important transformations in the rumen: lipolysis and biohydrogenation. Lipolysis refers to the release of fatty acids from the esters present in the lipids of food. Biohydrogenation is the process of saturation of the double bonds present in fatty acids [23].

As a consequence of ruminal microbial digestion, the lipids leaving the rumen are predominantly unsaturated saturated fatty acids (SFA) of food and microbial origin (70%), and variable amounts of microbial phospholipids (10-20%) [23].

Only 10-15% of the polyunsaturated fatty acids (PUFA) consumed in the diet escape ruminal biohydrogenation.

The main site of absorption of fats is the middle and final stretch of the jejunum although absorption also occurs in the initial stretch despite the low pH. In the upper jejunum, only the free fatty acids that reach the duodenum are absorbed with the digesta, while the fatty acids from the enzymatic digestion of neutral fats and phospholipids are absorbed in the final two thirds. The long-chain fatty acids are not absorbed in the large intestine [23].

Within the enterocytes, fatty acids of less than 12 carbons are not esterified and are drained directly by the portal vein. In contrast, fatty acids of 12 or more carbons are esterified to form triglycerides and phospholipids. Triglycerides, small amounts of mono and diglycerides, phospholipids and cholesterol synthesized in situ are attached to apoproteins to form chylomicrons and very low density lipoproteins (VLDL) that are drained by the lymphatic lacteal ducts to be incorporated into the bloodstream.

Although ruminal microbial digestion has the greatest influence on the preformed fatty acids available to tissues, de novo synthesis, desaturation in In situ and the transfer between tissues also affects the fatty acid composition of ruminant products [23].

The liver is the most important organ in the processing of body energy and has a complex role in lipid metabolism but has little influence on the preformed fatty acids that can be used by the adipose tissue and the mammary gland. Adipose tissue is the most important reserve of body energy and provides fatty acids to the mammary gland and the liver in situations of negative energy balance. Despite the high capacity of the mammary gland for the synthesis of fatty acids, most of the fatty acids exported in milk are taken from the bloodstream [23].

The digestibility of fats is acceptable if they occur in small quantities and in a very divided form. The digestibility of fats varies logically with the type of livestock that consumes them and, in general, is relatively acceptable in cattle and pigs and lower in other livestock species. It is accepted that the amount of fat in a food must have a certain relationship with that of proteins, and it is recommended that this ratio oscillate between 0.5 and 0.33 [2].

## F. Vitamins

The administration of vitamins in ruminants has taken interest in recent years, after discovering that its use in bovines, orally or parenterally, increases the weight gains in calves as well as the production and quality of milk in lactating cows [4].

Vitamins are important for the formation of catalysts and enzymes that support growth and body maintenance in animals. Vitamin A deficiencies occur when ruminants are placed in concentrated feed, or when they are fed dry forage and stored during winter. B vitamins are synthesized by ruminal microorganisms therefore no supplementation is needed. Vitamin D is synthesized in the skin when exposed to sunlight, therefore, vitamin E is the only vitamin of concern that sometimes needs supplementation [29].

### G. Minerals

Minerals constitute between 4-5% of the live weight of the animal, and their presence is necessary for the life and health of all species [9]. Mineral elements cannot be synthesized by animals, so their needs must be covered by the food they eat, since water and soil only provide small amounts. The sources are classified as natural (contained in food) and mineral supplements [33].

The absorption of minerals varies according to the different minerals. Highlighting the following absorption pathways [33].

Digestive tract: it is the most important, being the most active part, although variable according to the different minerals. Co, Na, Cl and K ions, more related to body fluids, can be absorbed by more than 70%. The absorption of the alkaline earth is between 5-70% and that of the metals Fe, Cu, Zn, Mn, etc. Does not exceed 5% In the small intestine divalent cations (Ca, Zn, Mn, and Fe) are absorbed and in the reticulum-rumen the Mg [11].

Respiratory system: Cadmium Skin: injection of certain compounds. As absorption mechanisms we would highlight simple diffusion in the monovalent ions Na, K and Cl, and facilitated diffusion in the divalent cations Ca, Zn and Fe. The absorption process is summarized in two stages. Passage through the intestinal mucosa and transfer to the blood plasma (which transports it to different tissues) [11].

#### III. NUTRITIONAL VALUE

#### A. Green Forage

They are products of vegetable origin also called voluminous or rude because they have low weight per unit volume. This classification includes products of great physical-chemical variability. Most of the forages included in this category have high levels of crude fiber (FB), more than 18%. The cell wall has a variable composition, but contains appreciable amounts of lignin (L), cellulose, hemicellulose, pectin, silica, and other components in smaller amounts. Lignin is associated closely to the carbohydrates of the wall with which they form complexes (lignohemicelulósicos) that hinder the enzymatic action [26].

## B. Hay

They are naturally dehydrated fodder (sun-cured) or in an artificial form to achieve conservation and be used in times of food shortage or strategic supplementation. According to their physical presentation they are called bales or rolls. The objective of the haymaking is to harvest the crop at the optimum state of maturity that provides the maximum production of digestible nutrients/ha. The state of maturity of the forage at cutting has a great influence on its quality [26]. To obtain good hay, the moisture content must be reduced to 20%, to facilitate storage without loss of quality. Other factors that contribute to its quality are maturity of the crop, haying method, climatic conditions during the harvest [26].

# C. Silage

It is the material produced by controlled anaerobic fermentation with a high percentage of humidity. There is production of organic acids, especially the acid. lactic, by bacteria that grow in anaerobic environment. Many factors intervene in the realization of a palatable silage of high nutritional value [27].

1)% DM of the forage before being placed in the silo.

- 2) Composition at the time of cutting.
- 3) Activity of the enzymes of the plant.
- 4) Presence of air.5) Type of microorganisms present and their development.
  - 6) Production of acids and organic bases.
  - 7) Appropriate acidity.

Initially, when the forage is placed in the silo, the dominant microorganisms are aerobic. The compaction of the material in the silo is required to reduce the amount of oxygen and favor a good fermentation. In 4 days, there will be hundreds of millions of lactic acid bacteria per gram of silage. The bacteria metabolize the soluble carbohydrates producing sequentially different acids, which will reduce the pH to 4-4.2, point at which acidity will inhibit other fermentations. The level of lactic acid in a well preserved silage is around 8%. The quality of the final product will be determined by the humidity level and the temperature during fermentation.

#### D. Straw and Stubble

Large amount of crop residues is available especially from annual crops. In general, they are characterized by having low PB% which has low digestibility, high levels of structural carbohydrates very lignified. Having been exposed continuously to the action of the sun and the rains, the resulting product has little energy, mineral and vitamin value. Its fundamental use is with ruminants, being the limitation the tenor of PB that is inadequate to maintain a normal microbial activity in the rumen [27].

## E. Concentrates

They are those that are added to increase the energy consumption or the density of the ration. Foods with a high energy concentration per DM unit and with less than 20% PB are included in this denomination. This classification includes grains, by-products of milling, fats, oils, and others available in smaller quantities and restricted to certain geographical areas [11].

## F. By-products of Agroindustry

From the production and processing of food by man, numerous by-products and waste are produced that can and should be destined to animal feed. A significant number of them have different nutritional characteristics according to the origin and type of industrial process. In general, they present the peculiarity of being very concentrated in one or more nutrients (proteins, lipids), so they must be analyzed carefully in order to combine them correctly, with other foods in balanced diets [14].

## G. By-products of Animal Origin

These are derived from three industries: dairy, refrigeration, and fishing. In general terms, they are foods that contain high quality proteins with an excellent balance of amino acids and very rich in minerals and vitamins. Except for those from the dairy industry, proteins are of low ruminal degradability (de-nominated by-pass). For the use of this group the following considerations must be taken into account [14]:

- a) Byproducts of animal origin usually contain significant amounts of fat and are very prone to oxidation and rancidity.
- b) They must be processed and stored properly to prevent the growth of microorganisms.
- c) In general, they are more expensive than by-products of plant origin.

## H. By-products of Plant Origin

From the processing to obtain vegetable oils, protein rich residues are obtained.

These residues are normally presented commercially in the form of pellets or flours. Its nutritional value many of the trace elements are essential for the organism, since they are an integral part of certain important organic substances (hormones, enzymes, and other active proteins). Therefore, they belong to the group of indispensable factors of food. The lack of trace elements is reflected in characteristic symptoms of lack, such as iron-deficiency anemia. It has been clearly shown that iron, copper, cobalt, manganese, zinc, iodine, molybdenum, and selenium are indispensable trace elements, that is, essential for life [27].

### IV. FEEDING OF CATTLE

A food can be defined as any component of the ration that provides nutrients. Most foods provide one or more nutrients and can also include ingredients to provide bulk, reduce the oxidation of nutrients that oxidize easily, provide flavor or other factors related to acceptability without strictly serving as a source of nutrients [27].

Foods for dairy cows can include stems, leaves, seeds, and roots of various plants. Cows can also be fed industrial by-products (oilseed flours, molasses, beer grains, mill byproducts) etc.). In addition, cows need minerals and vitamins to respond to their nutritional requirements.

Cow foods are often classified as follows:

- Forages;
- Concentrates;
- Protein supplement;
- Minerals and vitamins.

Fodder may also contain substances that have no nutritional value. Some components have complex structures (phenolic compounds) that are indigestible and that can interfere with the digestion of some nutrients (such as lignin and tannin). In addition, some plants contain toxins that are harmful to the animal's health. Phenolic compounds are some of the most abundant toxic substances in legumes. Within this group, condensed tannins are the most harmful, from the nutritional point of view, because they reduce the growth and digestibility of protein and amino acids. They cause alterations in the absorption of sugars and in the inhibition of digestive enzymes because they easily form strong and selective complexes with proteins and other macromolecules, such as carbohydrates and cell wall starches [32].

## A. Feeding Needs of Cattle

The goal of bovine feeding should be directed as much as possible to provide the nutrients so that the animal meets all its needs [13]. These needs have been estimated through various investigations, which in turn have contributed to the elaboration of the nutrient requirements tables of the NRC (National Research Council). Based on these tables, the requirements for production, gestation and maintenance are calculated [14].

#### V. IMPORTANCE OF NUTRIENTS IN BOVINE REPRODUCTION

For many years there is evidence of the impact of nutrition on the reproductive behavior of the bovine female. The main factor that affects reproduction is undernutrition due to the scarcity and quality of the food [15]. Subsequent research has shown that the nutritional effects are they exert through complex interrelations between diverse aspects such as: content and use of body reserves, distribution of nutrients between different systems and organs and prioritization of the use of nutrients for various functions besides reproduction [20]. Reproduction in animals is influenced by several factors, such as species, breed, body condition (CC) and nutrition. Within these, nutrition plays a recognized important role by directly affecting aspects of the physiology and reproductive efficiency in the bovine female [30].

The physiological changes and metabolic adjustments that occur in the dairy cow after birth are the best example of the relationship between nutrition and reproductive behavior, because during this phase several physiological events are intertwined: maximum production of milk, uterine involution, return of ovarian function, conception, and development of the embryo. It is evident that after delivery in the dairy cow of high production, the nutrient requirements for the mammary gland are priority in front of the tissues of the reproductive tract [15].

During the last weeks of gestation and the start of lactation, the dairy cows have a period of BEN (negative energy balance). The BEN occurs, among other things, because the peak of milk production is set 4 to 6 weeks before the peak of dry matter intake (IMS) and the energy used for maintenance and production of milk, is greater than energy incorporated with the food. When cows are in BEN, blood concentrations of non-esterified fatty acids (NFAE) increase, while those of IGF-1, glucose and insulin are low. This alteration in blood levels of these metabolites and hormones is generally associated with a compromise of ovarian function and fertility [31].

It is observed that for the beginning of lactation, the daily energy and protein needs increase considerably (between 5 and 10 times), in relation to those of the end of gestation. The previous situation demonstrates the great magnitude of the metabolic adjustments that the cow must make in order to maintain fetal growth and milk production and therefore the prioritization of functions to maintain a certain physiological state [23].

These considerations are framed in the proposal by [5], who were the first to propose the concept of homeorresis in relation to the regulation of metabolism at the end of gestation and at the beginning of lactation (transition phase). The concept defines the coordinated changes of the metabolism of different body tissues, necessary to maintain a dominant physiological state. The key characteristics of

the homeo-regulation are its duration, which includes longterm events (hours, days), unlike the time required for homeostatic regulation (seconds, minutes); it acts simultaneously in several apparently unrelated tissues and its action is carried out by altering tissue responses to homeostatic signals [16].

The transition stage is defined as the period from the three weeks before delivery until three weeks after delivery. During this period, the cow suffers a series of very important hormonal and metabolic changes that affect its capacity for consumption and nutrient requirements. At the same time, the rumen must adapt to the dietary changes of a diet high in fiber, with very little or no grain, to rations with more concentrates [6]. The dairy cow must make impressive metabolic adjustments in various body tissues, in order to supply the nutrient requirements for milk synthesis in the mammary gland [15]. From studies carried out with multiparous cows fed mainly with silage forages, it was determined that for the prepartum transition phase the diet should provide 140 g PC/kg DM in order to supply the necessary protein for maintenance, nutrition of the fetoplacental unit, development of the mammary gland and synthesis of colostrum [21].

A delay in postpartum ovulation is directly related to the energetic status of the cow, that is, the greater the BEN, the longer the time until the first ovulation. The delay in the first postpartum ovulation is associated with adverse effects on subsequent reproductive efficiency. Some researchers suggest that an earlier return to cyclicity is beneficial for reproductive performance, because an increase in the number of estrous cycles prior to artificial insemination (AI) is associated with a higher conception rate [30].

## VI. FACTORS OF NUTRITION THAT LIMIT REPRODUCTION, EFFECTS ON:

## A. Puberty

There are many studies that show how the level of nutrition is reflected on sexual maturity, according to the known relationship that exists between the general development of the individual, body growth and development of the reproductive organs [1].

The feeding conditions in which the animals are kept growing, represents one of the factors of greatest influence on the onset of puberty in heifers, since, its advent occurs during the growth stage, where it is more related to weight I live with the chronological age of the animal [18].

A model of optimal growth of rearing calves is one that allows them to develop their genetic potential for the production of milk at the desired age and at minimum cost. It is therefore important to understand and define this growth model since it will determine the age at first insemination, and the age and live weight at first birth [30]. Proper management will allow calves to reach sexual maturity to be covered at 13 months of age, be covered at 15 months, and develop adequately (> 575 kg) to face a full lactation before or around 24 months of age [19]. This time is very high compared to the ages reported in developed countries: 16-18 months (females) and 24 to 30 months (males). These inequalities are mainly determined by the differences in the feeding programs applied in one or another region, particularly in the stage of raising the calves. The need arises to transform, as soon as possible, an anatomically and physiologically monogastric animal (nonruminant) in a functional ruminant; that is, in an animal with the capacity to efficiently consume and transform the forage. In cattle, the development and change of the different compartments occurs rapidly during the first 3 to 4 months of life. The rumen capacity increases from 50 to 60 times during the first 16 weeks of life (from 0.5 lt to 30 lt) while the abomasum barely doubles or triples its volume (from 2 lt to 4-6 lt), these changes they are influenced in a decisive way by the handling of different food inputs during the first months of life [33]. The nutritional status determines the body size and the live weight throughout a lifetime. Low levels of nutrition during the prepubertal period delay the initiation of puberty by inhibiting the development of the endocrine reproductive system [1].

Puberty usually occurs or is associated with a certain weight, relative to adult weight or maturity. This weight can be achieved at an early or delayed age according to the imposed diet [33].

The feeding conditions in which the growing animals are kept, represents one of the factors of greatest influence on the onset of puberty in heifers, since its advent occurs during the growth stage, where it is more related to weight I live with the chronological age of the animal [33].

On the other hand, the effect on bovine reproduction of parasites, which indirectly damage the animal's nutrition and metabolism, indirectly affects reproduction, as is the case of the gastrointestinal parasites of the abomasum, the intestine. thin, large intestine and direct damage to the liver and liver metabolism, such as those caused by Fasciola hepatica, due to its effect on animal protein metabolism and metabolism and energy synthesis, which is reflected in lower rates of growth and development, by low deposition of protein and fat in the muscles, added to the effects on the mineral metabolism of calcium and phosphorus, on bone development and growth, which means a lower body development of the animal, with lower weaning weights, delay in age at puberty and age at first parturition [34].

When cows (Bos Taurus indicus) have low body energy reserves, they are more likely to suffer from diseases, metabolic disorders, reduced milk production and alterations in reproductive performance, increasing the age at puberty and at first birth. The main factor that affects the duration of postpartum anestrus in cows is nutritional status and breastfeeding. An inadequate consumption of protein and energy during pregnancy leads to a low body condition at the time of delivery, to this is added that the decrease in food consumption during early lactation (undernourishment) and the increase in glucose requirements for production milk, mark the appearance of a negative energy balance NEB), leading to an increase in the percentage of cows in anestrus and a longer time between births. The organism tries to maintain its homeostasis by mobilizing its reserves of lipids and proteins [17].

## B. Estral Cycle

Dairy cows are bovine females generally subjected to a more severe negative energy balance (BEN) in the postpartum period [30].

During the last weeks of gestation and the beginning of lactation, dairy cows have a period of BEN. The BEN occurs, among other things, because the peak of milk production is set 4 to 6 weeks before the peak of dry matter intake (IMS) and the energy used for maintenance and production of milk, is greater than energy incorporated with the food. When cows are in BEN, blood concentrations of non-esterified fatty acids (NFAE) increase, while those of IGF-1, glucose and insulin are low. This alteration in blood levels of these metabolites and hormones is generally associated with a compromise of ovarian function and fertility. A delay in postpartum ovulation is directly related to the energetic status of the cow, that is, the greater the BEN, the longer the time until the first ovulation. The delay in the first postpartum ovulation is associated with adverse effects on the subsequent reproductive efficiency. An earlier return to cyclicity is beneficial for reproductive performance, because an increase in the number of stroke cycles prior to artificial insemination (AI) is associated with a higher conception rate. Contrarily, other studies establish that in cows with earlier luteal activity in postpartum there is no evident relationship between the time of postpartum ovulation and fertility. One explanation for the negative effect of earlier postpartum ovulation on fertility would be the possible association between early luteal activity and delayed uterine involution. Likewise, a high incidence of persistent corpus luteum, usually associated with uterine infection, was observed in cows with more early luteal activity. Cows with persistent CL have a lower reproductive efficiency. During the BEN period there is a loss of CC in the cows, which is exacerbated by the decrease in food intake. This decrease in CC, often independent of the CC in which the cow was at calving, is directly associated with the delay in the first ovulation and the increase in the days of conception. The cows with greater loss of CC in the first weeks of lactation will present a worse reproductive efficiency, among them, those that will give birth with high CC. The mechanism by which BEN or loss of CC is related to delayed postpartum ovulation is probably associated with low pulsatility of LH. The restoration of normal pulsatility of LH is a determining factor for the initiation of follicular growth and cyclicity in postpartum cows. It was shown that a reduced availability of glucose and insulin is related to a lower pulse frequency of LH and a low production of IGF-1 by the liver, which reduces the response capacity of the ovaries to gonadotropins [21].

The high demand of growing cattle and fattening at high levels of production cannot be covered by the supply of nutrients from subtropical pastures. The lack of quantity and low quality are magnified during the winter period, where the crude protein is reduced to 4-6%. This generates a deficient availability of nitrogen at the ruminal level, affecting the adequate fermentation of the forage. Less than 50% digestibility of dry matter (DM) and metabolizable energy of 1.4 to 1.8 Mcal/kg/MS, determine an inadequate nutrient intake that severely compromises the productivity of animal production units. In addition to affecting the development and impact on the live weight (LW) of bovine growth, protein deficiency would generate low conception rate, decreased estrus, fetal resorptions, premature births, and weak offspring. With greater availability of MS and proteins, higher PV gains are obtained, and the fattening period is shortened [32].

## C. Pregnancy

The liver, the central organ of metabolism, is responsible for capturing the metabolic needs of all body tissues and responding to each of them, which is why it plays a key role in coordinating the flow of nutrients to meet the needs of the body. pregnancy and lactation [18].

The conception and establishment of pregnancy are interrelated events such as follicular development that results in ovulation, fertilization of the oocyte, transport and development of the embryo, maternal recognition of pregnancy and implantation. Hypothetically, ammonium, urea or some other toxic product of protein metabolism can intervene in one or more of these steps to impair reproductive efficiency. Ammonium is a metabolite of the protein that escapes the detoxification of the hepatic system of the cycle. of urea. Another metabolite of the diet protein is urea, which is formed by the detoxification of NH4 by the liver. The level of urea in the plasma or serum is a reflection of the amount and degradability of the protein consumed, the severity of the BEN and the combination of the consumption of protein and BEN [15].

BEN can be exacerbated when combined with an excess of protein in the diet. Therefore, the combined effects of excess PDR and energy status could in part justify the low embryo quality observed in lactating cows. The consumption of energy and protein should be adequate to optimize ruminal fermentation and the production of microbial protein. The microbial protein contains a limiting amino acid profile better than other sources of PNDR, and the sources of PDRs are less expensive than PNDR sources. High PB levels can increase plasma urea and ammonium levels, raising ammonium concentrations in the follicular fluid, and their effects on the follicle could lead to a subsequent reduction in embryo survival [21]. Different studies showed a lower rate of cleavage and fewer viable embryos obtained from oocyte donors that had higher plasma concentrations of urea and ammonium [21]. The low embryonic survival may also be due to a low concentration of progesterone. Diets with high PB reduce progesterone concentrations in lactating cows, but not in dry cows and heifers. Butler 7 reports that the negative effects of high protein can be mediated by a decrease in uterine pH which, in combination with the low in progesterone, creates a hostile uterine environment for the embryo. The uterine pH usually increases from about 6.8 in the heat to 7.1 on day 7 of the estrous cycle. Elrod observed that by administering a high protein diet to Holstein heifers, the uterine pH in the luteal phase was significantly lower compared to that of animals that received normal levels of protein in the diet, being similar to that observed in estrus. Regarding the first service conception rate, the results were 82% for heifers that received a diet with normal levels of protein and 61% for those that received the diet with high protein concentrations.

In this study, progesterone concentrations were not different between the groups [14].

On the other hand, it was observed that the rate of embryonic development was lower in lactating cows fed with excess PDR. In another study, meanwhile, there were no differences in the production of viable embryos between superovulated cows that had moderate (15.5 mg/dl) or high (24.4 mg/dl) plasma concentration of urea nitrogen. When these embryos were transferred to recipients, there was a higher pregnancy rate in those who received embriones from cows with a moderate concentration of urea nitrogen (35 vs 11%). The authors did not detect differences in the pregnancy rate among recipients with moderate or high plasma concentration of urea nitrogen [22].

The physiological changes at the end of pregnancy are framed in several aspects and have to do with: increased blood flow to the uterus and oxygen consumption by the fetus, uterus, and placenta; and the use of glucose amino acids, lactate and AGL. In metabolism, there is an increase in hepatic gluconeogenesis, reduction in tissue glucose utilization, decrease in peripheral acetate utilization and a moderate increase in FFA [15].

### D. Delivery

External parasites, such as ticks and biting flies, can also be attributed effects on bovine reproduction, mainly associated, as in the case of Nematodes and Trematodes, with negative effects on animal nutrition, which generate less development in the animal, therefore lower weaning weights and lower weight gain to reach the age of puberty and first birth, a great effect on energy and protein metabolism, which are associated with lower reproductive rates, than in animals not infested with parasites; Blood parasites, such as in the case of Trypanosoma vivax, are associated with abortions in animals with a term gestation [34].

As a result of numerous factors such as vitamin and mineral deficiencies, the retention of placenta in cattle may occur, this is considered a failure in the expulsion of the placenta, within 12 to 24 hours after the expulsion of the fetus, whose cause is considered multifactorial. Its repercussion is directly related to the decrease in the reproductive activity of the females, such as the continuation of open days and interval between births [11].

The need to improve the productive efficiency of the animal production units led to the implementation of different management practices, including the service of heifers at 15 months of age. By means of this technique a faster cycle of the entry of the replacement female can be obtained in the productive circuit of the bovine breeding. However, its implementation requires careful sanitary and nutritional management. Failures in the selection and management of this category in addition to the increase in size the reproductive system and the carelessness in the use of bulls suitable for the early service of heifers, brought with it an increase in the frequency of dystocic births [24].

The dystocic births represent important economic losses due to the increase in the loss of calves, increase in the attention of the female, decrease in the conception rate, increase in expenses for medicines and veterinary fees [24].

The fertility of heifers and cows for meat is affected by the consumption of protein before and after parturition. The results show that animals that have low protein consumption during pregnancy (50-80% of requirements) and postpartum in diets with different energy levels, have low pregnancy and conception rates at first service, compared to animals who receive diets with adequate protein content (100% of the requirements) [32].

It is possible that prolonged protein restriction results in a decrease in ingestion and digestion of nutrients and affects the distribution of body nutrients and thus causes an energy deficiency. The deficiency of protein and energy in the prepartum and postpartum, not only reduces the presentation of estrus but also delays the appearance of this and decreases the gestation rate of animals showing ovarian activity [15].

## E. Transition Period

Dairy cows make important metabolic and endocrine adjustments between the end of pregnancy and the start of lactation. Feeding strategies during this transition period (from 21 days before the date of delivery until 21 days postpartum) can contribute to increase the risk factors associated with metabolic disorders that limit production in the beginning lactation. Estimates of the amino acid, fatty acid and glucose needs of the mammary gland indicate approximately a two-fold increase in the demand for amino acids, five times in the fatty acids and 2.5 times the glucose demand, approximately 1000 g/day to 2500 g/day from the last days of gestation to the 21 postpartum day; in the case of glucose, the needs in the post-partum period exceed the supply from the consumption of dietary energy in more than 500 g/day [18]. The three weeks before and after delivery are a key moment for the success of breastfeeding that is initiated. In the opinion of many producers and nutritionists, the profitability of the same depends on proper management and feeding during the transition period [6].

### F. Postpartum

After delivery, the metabolic changes increase in order to initiate and maintain the milk synthesis. Part of the increase in the demand for nutrients is compensated by the increase in the consumption of food, however this does not accompany proportionally to the sudden increase in milk production, therefore, in the first weeks postpartum the cow enters a negative state of nutrient balance, which are estimated in animals with high milk production, in 7 kg/day of lipids, 3 kg/day of glucose and 330 g/day of amino acids [19]. In order to provide the high demand for nutrients from the mammary gland, metabolic alterations occur in various tissues. The main change takes place in adipose tissue where lipolysis increases. The mass mobilization of AGL is the main and most notorious metabolic change of the transition phase in the cow. AGL levels rise soon after delivery and gradually decrease in the postpartum period [15].

During this period, there is a suppression of lipogenesis and reesterification of fatty acids in adipose tissue. Approximately 20% of the mobilized AGL is used for the synthesis of milk fat, the rest is metabolized in the liver and muscle. When there is excess in the mobilization of FFA, incomplete oxidation occurs in the liver, which leads to

ketogenesis, elevating the ketone bodies to pathological levels (> 3 mmol/L) [22].

The uptake and esterification of AGL and the limited hepatic capacity for the synthesis and secretion of lipoproteins results in the accumulation of fat in the liver. In extreme cases there is an excessive accumulation, with the consequent harmful effects on reproduction. metabolism of carbohydrates after childbirth is associated with the massive requirements of glucose by the mammary gland for the synthesis of lactose, which are estimated at approximately 1800 g/day for cows that produce 30 kg of milk per day. However, assuming that the totality of propionate and amino acids are available for glucose synthesis, these substrates only contribute 66% of the requirements (1200 g/day of glucose). Other sources of glucose are glycerol from the lipolysis of triglycerides and lactate of endogenous origin or from the diet. It is also known that an option for the synthesis of glucose are labile muscular protein reserves, which are estimated between 500-600 g/day of amino acids in the first week of lactation for a cow of 30 kg of milk per day [22].

In postpartum, the greatest source of amino acids for milk synthesis is skeletal muscle through the catabolism of proteins. In contrast, in the liver increases the synthetic activity of proteins and the efficiency of the use of amino acids. The changes begin at the end of pregnancy and increase significantly after delivery. It also increases the hepatic mass and the size and functional capacity of other digestive organs that are required to obtain the maximum consumption of food and a greater digestive capacity. The increase in protein synthesis in the liver occurs when the consumption of dry matter and the absorption of amino acids is low (first week of lactation). This is a clear example of the homeorrhetic response prior to a physiological state change [15].

## VII. CONCEPTION RATE

Diets with unsaturated fatty acids of the n-3 family can have a positive effect due to their potential action in reducing the secretion of PGF2α by the uterus and by a decrease in the sensitivity of the CL to it. In addition to the positive effect on reproduction in dairy cows, feeding Nelore cows during the period service with fat rich in polyunsaturated fatty acids has shown favorable results on conception rates. López et al., Administered Megalac-E (ruminal or protected bypass fat) for 28 days after the IATF and observed an increase in pregnancy rates (56.5%, n = 200) compared to a group without supplementation (45.6%, n = 211, p = 0.015).

Subsequently, this same group performed an experiment with supplementation between the time of AI and the diagnosis of pregnancy and also observed a higher conception rate in cows that received Megalac-E (48.2%, 81/168) in relation to those that did not receive it (33.9%, 58/177) or those supplemented with minerals and protein (26.4%, 63/238. A diet with sunflower seed (rich in linoleic) was administered in postpartum Nelore cows (n = 133) from the time of AI until 22 days later and a 20.4% increase in the conception rate for cows was observed who received this diet. On the other hand, a recent study did not observe a positive effect of Megalac-E supplementation on embryo production in Nelore donors.

## VIII. FOOD ALTERNATIVES TO IMPROVE REPRODUCTION

Basically, the nutritional requirements of the animal species must be taken into account in conjunction with the physiological state in which it is found. For example, dry cows, which goes from drying to three weeks before delivery. Their diets are usually high in fiber, moderate in energy and with little or no concentrate. Preparto, includes the three weeks before delivery. The density of energy and protein is increased due to the increase of requirements and fall in the consumption capacity. Some grain is included to achieve a rumen adaptation. Forages should be low in potassium to prevent hypocalcaemia problems [6].

Fresh cows or "fresh" cows, which includes the three weeks postpartum. The requirements are increased due to milk production, consumption capacity is low, and the cow must complete its ruminal adaptation to larger quantities of grain that it will receive at the peak of lactation [6].

High production cows, the requirements are maximum for the cow to achieve the maximum production peak [6].

The high demand of bovines in growth and fattening in high levels of production cannot be covered with the supply of nutrients from pastures [8], therefore the need to supplement this makes it possible to improve the profit of PV of the animals, the efficiency of conversion of the forage base and the shortening of the cycles of rearing and fattening [32].

Due to the growing demand to supplement by the producers, numerous investigations have been carried out, trying to find the best nutritional values to satisfy these needs. When carrying out a study with marine vegetation (VM) they found that it represents a great resource for the benefit of man, being composed basically of algae and marine grass. Regarding its nutritional value for animals, algae containing 17% protein have been reported. Studies on its mineral profile have revealed a high content of iodine and sulfur, a good level of potassium and a moderate content of cobalt [8].

Another alternative in which great benefits have been observed is the use of by-pass nutrients (proteins, amino acids, lipids, starches), however the results achieved so far are inconclusive, mainly with respect to proteins and carbohydrates [8].

Under grazing conditions, the available information is very scarce and in some cases contradictory, partly due to the low production levels per animal that are achieved in these systems and on the other to the natural imbalances of the preponderantly pastoral feeding, with its multiple interactions [10].

By-pass nutrients are economically more expensive inputs and their use under grazing conditions should be restricted not only to cows of very high genetic merit, but mainly to feeding programs where previously emphasis on the correct balance and balance of the normal ingredients of the diets (pasture, classic concentrates, preserved forages) [16].

The use of lipid substances protected from ruminal fermentation arises as a challenge for the feeding of cows of very high productive level, which easily enter into a deep

negative energy balance after childbirth. supplementation with lipids by-pass increases the energy density of the diet in this type of cows, without the metabolic risks that the intensive use of large amounts of grains implies. Very effective methods are currently available to protect these nutrients and several commercial products of high quality available in the market [16].

The positive effect of fat on reproductive function is mainly due to polyunsaturated fatty acids. The positive effects of fat supplementation in dairy cows may be due to the stimulation of follicular growth associated with an increase in energy balance [14]. Some studies showed an increase in the follicular population and / or in the size of the ovulatory follicle in cows supplemented with calcium salts and with long-chain fatty acids [32].

The addition of fat in the diet also influences the luteal function in three ways: by direct action on the production of progesterone, by alteration in the production of eicosanoids within the luteal tissue and / or by the interaction with the control system of the luteolysis and maternal recognition of pregnancy [15]. The fatty acids of the n-6 family (such as linoleic acid) increase the synthesis of prostaglandin, while those of the n-3 family (such as linolenic acid) can reduce arachidonic acid and prostaglandin synthesis. Therefore, two fat supplementation strategies have been proposed in dairy cows. One, with unsaturated fatty acids of the n-6 family during the peripartum period and another with unsaturated fatty acids of the n-3 family during the insemination period. The diet with unsaturated fatty acids of the n-6 family, by increasing the synthesis of prostaglandins and acting on follicular growth can have a beneficial effect on the childbirth, in addition to helping post-partum uterine involution, re-establishing cyclicity earlier and aiding in follicular growth and ovulation [15].

In this regard, it should be considered that the lipids bypass exerts a positive influence on the concentrations of butyric fat of the milk but that nevertheless can be negative for the milk protein. To avoid this, a diet should be formulated that does not contain more than 400 g of protected lipids, supplementing mainly during the transition phase and early lactation, when the cows of high genetic merit manifest in full the "negative energy balance" [16].

must be considered Finally, it supplementation with protected lipids, always for high production cows, has also shown positive effects on reproduction.

## IX. CONCLUSION

To achieve animals with optimal cyclicity and fertility, it is necessary to carry out an adequate nutritional management, respecting the nutritional requirements of each zootechnical category. However, mainly in dairy cows, a paradox occurs. For the cows to produce more milk it is necessary to increase the intake of dry matter. This, in turn, is related to alterations in the patterns of cyclicity and behavior and decrease in fertility. To counteract, or to alleviate this problem, some strategies were proposed such as preventing or reducing the loss of postpartum CC, adding fat strategically to diets and the use of hormonal programs for the synchronization of heat and / or ovulation.

Dairy cattle as well as fattening cattle need the administration of vitamin and mineral supplements to efficiently achieve their production either of milk or meat, and many other cases to help them cope with different situations of stress, diseases, or stages physiological in which the animal.

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