

The Importance of Artificial Breastfeeding in Goat Breeding – Literature Review

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Abstract: It is well established that the breastfeeding period is of crucial importance for a good development of the goats. Breastfeeding may happen naturally or artificially and goats differ from other species due to problems that may occur if they are breastfed naturally, such as the transmission of Caprine Arthritis-Encephalitis (CAE) and inadequate closure of the esophageal gut, leading to problems such as diarrhea, bloating and even death. Goats are ruminants and have an anatomical structure called esophageal gut which closes when animal is breastfed properly and not allow the ingested liquid to reach the rumen and then go straight to the abomasum, in addition to this desired aspect there is the dissemination of Caprine Arthritis-Encephalitis that can only be avoided with quality artificial feeding, since colostrum is the main source of transmission for this disease. This study aims to better understand the artificial breastfeeding in the creation of goats through a bibliographic survey in several databases. The understanding of methods to manage such an important point as the proper feeding of baby goats in order to prevent CAE is of high importance in goats breeding and justify the pursue of specific knowledge for so.

Key words: Breastfeeding. Dairy goats. Food management. Neonates. Viruses.

Introduction

Goat breeding is an activity with great potential to be explored although not being properly supported by government actions as it happens with other types of cultures, e.g., bovines.

It is important to recognize the social relevance of this activity being very present in family agriculture by assisting in their subsistence, especially in the Northeast region where the majority of the caprine herd and milk production in the Brazil is concentrated, despite the low productivity achieved in this region. (Nascimento and Lima, 2015, Perdigão et al., 2016).

In the southeast region of Brazil we can see a more technically improved caprine production dedicated to a market niche geared towards value-added products, "gourmet" or even nutraceutical products (Perdigão et al., 2016).

Goat breeding has been linked to human societies since the beginning of civilization and was important to assist in the establishment of fixed settlements, providing meat, skin and milk, which mostly remains until these days. (Sampaio et al., 2009).

Goat's milk has 20% more calcium and up to 30% less cholesterol than bovine milk, with less sugar and similar amounts of protein and vitamins. It is easier to digest as it is absorbed after an average time of 40 minutes, while bovine milk takes about two hours. It is alkaline as well as breast human milk while bovine milk is acidic, being a great

substitute for human milk in infant lactation, especially for children with lactose intolerance (Guimarães, Cordeiro, Cordeiro, 2004) .

The transition from life in the uterus to the external environment requires rapid adaptation of the newborn. Good care in the first 24 hours of life can prevent death. One of the essential cares is related to the supply of colostrum to the newborn (Gorino, 2011).

Feeding the goats can be done naturally or artificially. Natural breastfeeding requires less labor since the baby stays 24 hours with the mother in the first days suckling directly in her, and after a certain period of time they are taken apart and brought together to his mother in specific times. In the first days of baby goats they tend to suck small volumes of milk several times a day, this is specially important not to overload their abomasums.

Despite the lower cost, this system has not been recommended for intensive breeding systems since goat's milk is a via of contamination for Arthritis-Caprine Encephalitis (CAE). Though It is recommended for agroecological systems because it is closer to natural. To comply with agroecological systems it is necessary that the goats produce at least three liters of milk / day and a strict control of the presence of CAE viruses. (Fonseca et al., 2012; Silva, Rodrigues, 2003; Ribeiro, 1997).

Seeing goat breeding as a relatively recent commercial activity but with a great potential for growth and improvement it is extremely important to understand the mechanism of feeding these animals, specially in the first phase of their lives. This phase is of great importance for the success of the breeding since for the newborns to have a correct development, and also taking into account animal welfare practices, it is crucial that the feeding is done efficiently with the correct food in the right way of feeding them (Venturino et al., 2019).

Therefore, the objective of the present study was to better understand the types of breastfeeding in goat farming, their advantages and disadvantages and how they are carried out.

Methods of artificial and natural breastfeeding

When it comes to the period of lactation of the puppies it is possible to do it in two ways, by natural breastfeeding or artificial feeding. In the first one the puppies stay with their mothers in the first week of life, from then on they are separated and taken back to her to suck according to the recommended animal needs that may vary a little according to different recommendations, and it is generally recommended that it happens twice a day. The use of this method has been decreasing over the years although it does not need such specialized labor force and the kids end up sucking more small amounts of milk not overloading their abomasum, this method makes it difficult the handling of the herd (Ramos et al, 2004; Silva, Rodrigues, 2003).

The artificial method can be imposed due to multiple birth, death after childbirth, low level of production, use of milk for sale, avoiding the spread of diseases, especially

the CAE. If done properly, it can increase profitability in goat breeding (Ramos et al, 2004; Silva, Rodrigues, 2003).

Table I. Comparison between artificial and natural breastfeeding methods

<i>Natural Breastfeeding</i>	<i>Artificial Breastfeeding</i>
Already awaited by the animal	Animal welfare
Less milk for sale	More milk for sale
Facilitates the spread of diseases	More efficient sanitary control
Feeding only goat's milk	Providing nutritionally effective food

Source: Own authorship

Esophageal gutte

The development of the rumen is influenced by the age of the animal, formation of the esophageal gutte and nutrition. Knowing about this makes it possible to design adequate management, aiming at obtaining the best performance of the animals (Júnior; Caetano; Oliveira, 2016)

When ruminants are born they have an anatomical structure called the esophageal gutte found in the compartmentalized stomach of ruminants. It extends from the orifice of the ostium to the omaso and has the capacity to become a closed tube. The closure of the gutte is caused by efferent impulses that reach the brainstem and afferent stimuli that are born centrally and in the pharynx by vagal reflexes. The central stimulus occurs due to the act of sucking while the pharyngeal occurs when the liquid diet comes into contact with the receptors of the pharyngeal region. Factors such as breastfeeding and a variety of sensory and neural stimuli cause the muscles to contract around the esophageal gutte. These muscular contractions close the groove, allowing the fluid to pass directly through the rumen, and reaches the abomasum where it will be digested (Correa, 2016).

At around twelve weeks of age there is less stimulation for the closure of the reticular sulcus in animals fed on the bottle or in the bucket. Likewise, the administration of milk and other fluids via the esophageal catheter leads to an inadequate closure of the reticular sulcus, since they do not come into contact with the pharyngeal receptors (Feitosa, 2016).

Esophageal gutte has an important function in lactating animals and the closure reflex appears to decrease after the weaning of animals and to advance in elder ages, but this reflex is also stimulated by the antidiuretic hormone thus indicating that it may have some function in adult life (Herdt, 2004).

Caprine Arthritis-Encephalitis (CAE)

A keypoint demanding special attention in artificial feeding is the prevention of the spread of the Caprine arthritis Encephalitis (CAE) virus, which is part of the group of small ruminant lentiviruses (SRLV), composed of 5 genotypes and 28 subtypes (Michiels et al., 2020; (Michiels et al., 2018; Norouzi et al., 2015).

Is an important viral disease that especially affects dairy goats with serious social and economic implications because presents low morbidity and infected animals sometimes go unnoticed, acting as a source of infection for the entire herd (Bezerra Júnior et al., 2018; Jesse et al., 2018; Milczarek et al., 2018; Silva, 2005).

There is still no effective treatment and due to its high mutation rate, it is not possible to manufacture a vaccine, which makes the practice of control measures even more important (Colussi et al., 2019; Norouzi et al., 2015).

Caprine arthritis Encephalitis can manifest mainly through five distinct clinical conditions: arthritis, encephalitis, mastitis, pneumonia and chronic weight loss. The arthritic way is the most important and is usually observed in animals over the age of eight months, mainly affecting the carpal joints where it is possible to observe an increase in the consistency and size of the joints. The mammary form frequently occurs and strongly affects economically the activity as it compromises milk production (Bilbao-Arribas et al., 2018; Gomez-Lucia, Barquero; Domenech, 2018; Singh et al, 2017; Smith et al., 1993).

Up to four months of age the most common form is encephalic (which may occur in adults, associated with arthritic conditions). The animals maintain normal appetite and remain active but present ataxia and bilateral or unilateral paralysis of the hind limbs (Gomez-Lucia, Barquero; Domenech, 2018; Narayan et al., 1992; Crawford & Adams, 1981).

The main route of elimination of the virus is the colostrum of infected goats, effectively being the main route of transmission. The virus can also be transmitted by infected needles, syringes, tattooing, fomites, and milking machines. In addition the virus can be transmitted through artificial insemination with infected semen (Souza et al., 2013). Congenital transmission rarely occurs, when it happens it is usually associated with multiple gestation (Santos, 2006).

It is necessary to take extra care with neonates in creations where the virus is present because colostrum is the main route of transmission, though it is highly recommended that baby goats are not fed directly from their mothers, an artificial method to supply colostrum or any of its possible replacements should be implemented. (Blood et al., 1991).

The association of separation or disposal of seropositive animals together with the use of certain management practices after the positive diagnosis, especially of the young, are the main ways of preventing the spread of the disease since there is no vaccine or effective treatment. To avoid contamination of the baby goat it must be separated from the goat that has the virus immediately after birth without allowing it to nurse colostrum directly or to be licked by the mother (puppies should receive goat colostrum proven negative for the virus or pasteurized colostrum). In any case the ideal procedure is to adopt some method that prevents the babies of nursing colostrum directly from their mothers after birth, regardless of whether the mother goat has the disease or not (Santos, 2006; Callado et al., 2001).

Colostrum

It is important to emphasize the importance of the digestive system in the protection and survival of the newborns since they acquire immunity exclusively after birth through the absorption of immunoglobulins present in colostrum. (Feitosa, 2016, Metzger, 2013, Berg et al., 2005).

Colostrum is the first secretion produced by the mammary gland after the dry period and is rich in lipids, proteins and immunoglobulins and contains carbohydrates in low concentrations. It has antimicrobial factors such as lysozyme, lactoferrin and lactoperoxidases, which prevent the development of a pathogenic enteric bacterial flora in the neonate, as well as cytokines (IL-1 β , IL-6, TNF- α and INF- γ) involved with the development of the immune system of the newborn and the stimulation of the recruitment of plasma cells to the labial gland, secreting a greater amount of IgA in the saliva (Matsuawa et al, 2018; Klein, 2014; Tizard, 2012; Butler, 1993).

The efficiency of transferred passive immunity depends on factors such as immunoglobulin concentration in colostrum, volume ingested, time between birth and ingestion, absorption capacity, and colostrum sanitary standards. (Davis and Drackley, 1998).

Puppies should be given at least 10% of their body weight by volume of colostrum between 8 and 12 hours after birth and it is important to make the first delivery within the first 2 to 3 hours of life. If the puppy is not born healthy colostrum should be given as soon as possible (Carlson, 2014).

Colostrum of the caprine (usually pasteurized) and bovine species is generally used. In an experiment carried out by Lima et al. (2009) aimed at determining the fluctuation in serum antibody levels in goats in the pre and postpartum periods and the efficiency of the process of acquisition of passive immunity in newborn goats using colostrum of both species, seeking to evaluate an alternative management of colostrum, it was found that in the group that received bovine colostrum the maximum concentration of total proteins and immunoglobins was verified much more quickly than in the group that received goat colostrum. The use of bovine colostrum is desirable, due to the promotion of better initial collection of immunoglobulins to neonates.

At the same time, in an experiment conducted by Yanaka (2009) that aimed to determine the period of intestinal absorption of collagenous macromolecules in goats fed with bovine and goat colostrum, also attempting to evaluate possible variations of biochemical, hemogasometric and immunological parameters of goats and baby goats until 75 days after birth. Goats that ingested bovine colostrum until 12 hours after birth acquired regular immunoglobulin titers. After 22 hours of birth the goats did not have adequate absorption of colostrum macromolecules and the passive immunity transfer failed. At 75 days, inadequate IgG concentrations were found in all goats. In addition, those who ingested goat colostrum had higher IgG concentrations when compared to those who ingested bovine colostrum.

So, the immune status during the first days of life based on the ingestion of colostrum and the time it was ingested, may affect the animal's body weight (Matsukawa et al., 2018; Hernández-Castellano et al., 2015).

Bottle Feeders

There are several types of bottles available for this purpose in the market which are basically divided into bottles, nozzles, buckets and gutters, varying according to the level of technology, materials and the way of use. There are three types of bottle, the common bottle which is the same used for children. Recommended for baby goats and its cleaning is laborious. You can adapt other types of larger bottles with nozzles that are available in the market allowing the output of a larger volume of milk. The Meurer type bottle, which was developed by an engineer from Minas Gerais uses nozzles in six aluminum pipes that connected to the bottom of a container, allowing the milk to escape by suction. And the automatic bottle in which some models have a reservoir for powder milk which is connected to water, using electricity and automatically homogeneization. This model also allows temperature and milk concentration to be controlled and the availability of milk to animals at all times. It allows economy with labor force since they can breastfeed up to 250 animals, and leads to animals faster growth due to the fact that milk is permanently available to the animals, although with the great consumption of milk it becomes expensive and delays the introduction of solid foods in the diet, in addition to increased animal stress (Ribeiro, 1997).

Recommended for large farms and properties with expensive labor, there are nozzles with valves made of rubber attached to buckets controlling the flow of milk, placed in the lower part of the vessel. More common there are the buckets from which animals drink milk directly, but, since they drink the milk with the head lowered there may damage the formation and function of the esophageal gutte, allowing the milk not to go directly to the abomasum. And finally there is the gutter, used for collective feeding which can be made of metal or plastic (Ribeiro, 1997).

Alternatives to goat's milk

In order to choose what will be offered to the newborns during the breastfeeding period it should be considered the goat milk market (demand and quantity available for sale on the farm), the presence of CAE and the availability and easeness of finding a replacement for goat's milk (Ribeiro, 1997).

Milk is considered one of the most complete foods because it has several important elements for human nutrition such as organic and nitrogenous matter, casein and albumin necessary for the formation of tissues and blood, minerals for the formation of the skeleton and vitamins, certain digestive enzymes and lactic ferments, the latter very favorable to digestion and responsible to protect the intestine from the harmful action of many pathogenic bacteria, because its ingredients can help the formation of a healthy intestinal microbiota (Ele et al., 2018; Guerra et al., 2007).

Milk replacements must be high quality food provided to animals before weaning in order to reduce producer costs and leave total goat milk production available for sale (Rodriguez, 2005).

There are several possibilities, both of goat milk and other replacements. Goat's milk can be used in both natural and artificial breastfeeding, its use in artificial breastfeeding will depend on the goat milk market and it is recommended that it be offered only after pasteurization. Usually cow's milk is the most used because it is easy to find and has similar results but caution is required with the possibility of disease transmission, in case of doubt only should be offered after boiled or pasteurized and has a lower digestibility than goat's milk (Kumar et al., 2016; Ribeiro, 1997).

Besides goat and cow's milk there are also three other major types, milk from other species, generally uncommon, but buffalo milk may be used for example, being necessary to analyze its composition and in some cases to make adjustments through dilution with water. The powder milk, which in most cases is not a good choice, and the powdered milk used for humans is a feasible alternative, in this case special attention should be paid to the presence of soy in its composition. And straight soy milk, which can only be used in the days closing the weaning of the animals. This condition is specially due to the fact that up to 40 days of age the puppies do not have sufficient enzymes for degradation of vegetable protein, so its use before the effective action of these enzymes can lead to problems such as bloating, diarrhea and death (Ribeiro, 1997).

Finally there is also the possibility of using diluted bovine colostrum, although uncommon it is a viable practice in properties with frequent bovine births with surplus of colostrum, for example. Caution is required because bovine colostrum is more concentrated and dilution with water is required (Ribeiro, 1997).

The amount to be offered to each puppy is somewhat controversial, varying by age group. Some authors recommend 1 to 2 kg of milk per puppy per day. There are also recommendations based on the daily amount of milk in relation to the live weight of the animal, or 10 to 25 percent of the animal's live weight. It is generally recommended to provide around 16% to 20% of the live weight of the animal, adjusting the amount weekly up to 49 days of animal age (Medeiros, 1994).

Conclusions

The breastfeeding phase is extremely important and it is crucial to manage it effectively. Natural breastfeeding is little used being present only in properties with few manpower and no technology or in those so-called organic production, because it is the method that better contemplates the natural behavior of the animals. On top of this resides the risk of dissemination of Caprine Arthritis-Encephalitis, a major disease that is detrimental to production which transmission is mainly through natural breastfeeding.

Comparing the aforementioned method with artificial feeding we can see that the second one has gained more and more space in goat breeding, allowing a better zootechnical control thus influencing the better development of the puppy improving

the quality of the production and in the success of the breeding. In addition it allows to control the dissemination of CAE, since both colostrum or goat's milk (if not replaced) will be offered pasteurized, which improves animal welfare and sanity of the entire flock. It is also important to remember that this method allows for the replacement of goat's milk for something more convenient, nutritionally and financially and can be provided in a variety of ways, provided that it is chosen the most appropriate way taking into account the importance of esophageal gutter for ruminants .

So, artificial breastfeeding is a viable and extremely important alternative to goat breeding.

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