

## Classification of udder edema in cattle: systematic review

## Classificação do edema de úbere em bovinos: revisão sistemática

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**ABSTRACT**

Dairy activity in Brazil is in a process of intensification due to the low rates of financial profitability of the production systems. The search for increased profitability makes producers and technicians use management strategies that challenge animals to expose their full genetic potential. On the other hand, the increase in individual productivity can result in the occurrence of metabolic and physiological disturbances, such as udder edema. This disorder is characterized by excessive fluid accumulation in the intercellular spaces of the breast tissue and is more evident in primipara and peripartum. The disease causes discomfort, difficulty in walking, pain, a drop in food intake, and predisposes the animal to mastitis. The etiology of udder edema is not fully known, but studies show that diets rich in concentrates and high sodium and potassium intakes are predisposing factors for its occurrence. In this sense, the objective was to carry out a systematic literature review to assess and define classification standards for udder edema in dairy cows, which can be used in the field to guide the control and treatment of the disease. For the bibliographical survey, six documents were used that answered positively to the following question: Is it possible to carry out a standardized classification regarding the degrees of mammary gland edema in cattle? Difficulty was found in locating publications involving the classification of this disease, which is related to the scarcity of studies on udder edema.

**Keywords:** Edema, Mammary gland, Swelling, Dairy farming, Udder.

**RESUMO**

A atividade leiteira no Brasil encontra-se num processo de intensificação, devido às baixas taxas de rentabilidade financeira dos sistemas de produção. A busca pelo aumento da lucratividade faz com que produtores e técnicos utilizem estratégias de manejo que desafiam os animais a exporem todo o seu potencial genético. Por outro lado, o aumento da produtividade individual pode resultar na ocorrência de distúrbios metabólicos e fisiológicos, como o edema de úbere. Essa desordem é caracterizada pelo acúmulo excessivo de fluido nos espaços intercelulares do tecido mamário, e é mais evidenciada em primíparas e no parto. A doença causa desconforto, dificuldade de locomoção, dor, queda na ingestão de alimentos, e predispõe o animal à mastite. A etiologia do edema de úbere não é totalmente conhecida, porém estudos mostram que dietas ricas em concentrados e ingestão elevada de sódio e potássio são fatores predisponentes para a sua ocorrência. Neste sentido, objetivou-se realizar uma revisão de literatura sistemática para avaliar e definir padrões de classificação do edema de úbere em vacas leiteiras, que possam ser utilizados à campo para direcionar o controle e tratamento da doença. Para o levantamento bibliográfico foram utilizados seis documentos, que responderam positivamente à seguinte pergunta: É possível realizar uma classificação padronizada quanto aos graus do edema de glândula mamária em bovinos? Foi encontrada dificuldade para localização de publicações que envolvem a classificação desta enfermidade, o que está relacionado com a escassez de trabalhos sobre a doença.

**Palavras-chave:** Edema, Glândula mamária, Inchaço, Pecuária leiteira, Úbere.

## 1 INTRODUCTION

As dairy producers aim for larger productivity in a short period of time, there has been an intensification of milk production, and as a result, some physiological and metabolic disorders have become more prevalent in herds of dairy cattle. In this context, the disease known as breast edema or udder edema stands out, which, depending on the growth, can cause damage to the cow's health and financial losses in the dairy industry, thus reducing profitability.

Udder edema is a peripartum disorder characterized by the excessive accumulation of fluid in the intercellular spaces of the mammary gland tissues. Physiologically and anatomically the mammary gland is highly vascularized, which makes it more susceptible to the development of localized edema (GHODASARA et al., 2012).

According to Bacic et al., (2007) the mammary gland, during the end of pregnancy, undergoes extensive chemical and physical changes, which probably contributes to the development of localized edema. Udder edema causes handling problems, such as difficulty in milking, an increased risk of residual milk, injuries and mastitis, which can reduce milk production throughout lactation.

The occurrence of edema is more common in heifers than in adult cows and, in many clinical cases, the swelling of the udder progressively decreases with milking. However, in some animals this disorder can become severe, causing pain and discomfort, and requiring immediate veterinary intervention. In subacute and acute clinical conditions, secondary inflammatory and infectious processes, such as mastitis, can affect the animal and may present clinical or subclinical characteristics (MARÇAL, 2006).

Although the physiological processes that most frequently trigger udder edema are not known, some scientific works are investigating the factors that lead to this pathology, with a nutritional cause being the most researched. Other correlated factors are: genetics, hormonal conditions in the peripartum period, body condition score, lack of movement in the maternity ward, advanced age at first birth, animal size at birth, milk productivity, season of the year (especially winter) and consumption of some ions such as sodium and/or potassium (MELENDEZ et al., 2006). Furthermore, oxidative stress results in the production of reactive oxygen metabolites, which can also contribute to the development of udder edema (BACIC et al., 2007).

According to Guerreiro (2017), mammary gland edema may appear 14 or 21 days before delivery or very close to it. The most common clinical findings are edema due to the mammary gland (which may extend to the ventral parts of the abdomen), a decrease in dry matter

consumption, low peak production after childbirth, pain, discomfort, difficulty walking and local wounds caused by trauma due to the edema.

The occurrence of the inflammatory process, especially in the most severe cases of udder edema, presents, in addition to changes in vessel permeability, predisposition to fluid leakage (edema), hyperemia (heat and local redness), vascular changes linked to vasodilation, increased blood viscosity and reduction of regional blood circulation. The five cardinal signs of inflammation - pain, heat, redness, edema and loss of function - vary in intensity according to the severity of each animal's clinical condition (TIZARD, 2014).

As for the treatment, Santos and Fonseca (2019) reported cases of udder edema that had a natural cure in the first week after parturition. However, when this does not occur and the edema is prolonged, a pharmacological intervention with anti-inflammatory drugs and diuretics is necessary.

## 2 MATERIAL AND METHODS

This work consists of a systematic literature review based on the elaboration of a research question that guides the search strategy; a variety of sources for finding studies; the definition of inclusion and exclusion criteria; and the evaluation of the methodological quality of the researched productions.

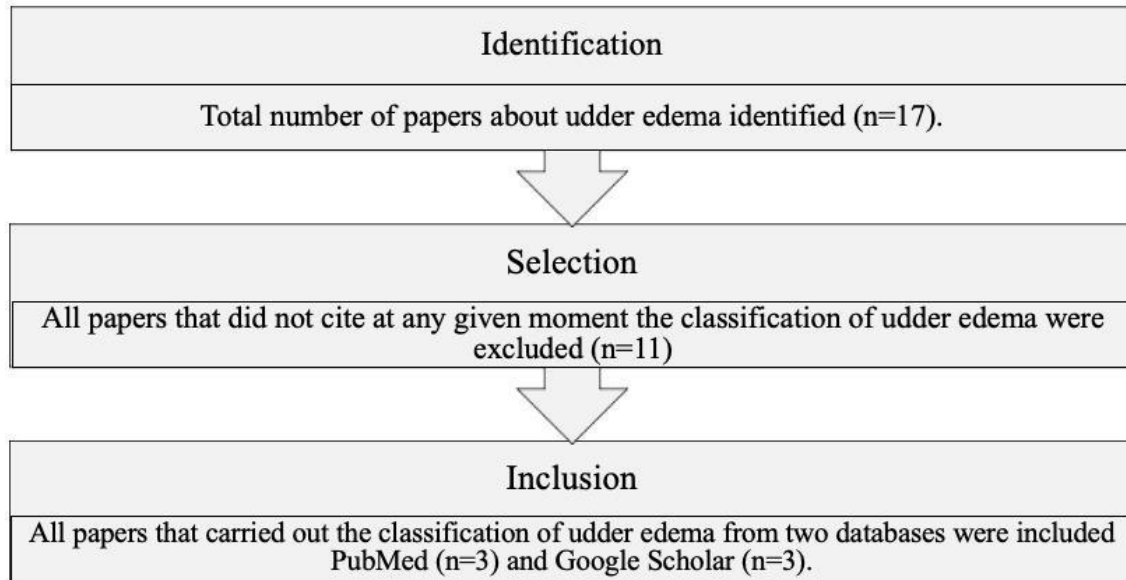
The survey of bibliographic data occurred in October and November 2020, based on the inclusion criteria included. The first stage of the literature review was carried out by reading and analyzing the titles and abstracts of all identified articles. After this initial screening, the selected studies were read in full, which allowed for other texts to also be excluded for not meeting the proposal of the review.

The articles were selected through the PubMed and Google Scholar indexing platforms, bringing together research with definitions of different publication periods and compiling research from the 1950s to the present. National and international articles were used, and regardless of the place of development of the consultation bases used, udder edema presents itself in the sameway. In the search for the indexing bases, keywords were applied in both Portuguese and English: a) "udder edema in bovines"; b) "changes of the mammary gland in the peripartum period"; c) "postpartum mammary gland inflammation".

At the end of the research, six scientific articles were selected that describe changes and possible justifications for udder edema. When evaluating the studies, the classification of udder edema was noted in a similar way; however, the characteristics of the different degrees of udder edema in cattle were not evident in the literature.

The present systematic review carried out the compilation of data from the studies, seeking to clearly define a standardized classification regarding the degrees of mammary gland edema in cattle (Figure 1).

Figure 1. Flowchart of the selection of reviewed articles



### 3 RESULTS AND DISCUSSION

Table 1 shows the compilation of data from the analyzed articles regarding the classification of udder edema scores in cattle.

Table 1. Classification of udder edema scores in cattle

Author	Classification score	Classification					
		0	1	2	3	4	5
MORRISON et al. 2018	0-3	No edema	No edema	Mild edema	Moderate edema	-	-
RANDALL et al. 1974	1-5	-	No edema	Mild edema	Moderate edema	Severe edema	Very severe edema
SCHMIDT et al. 1959	1-5	-	No edema	Mild edema	Moderate edema	Severe edema	Very severe edema
BALMER <sup>1</sup> et al. 2018	0-3	No edema	Mild edema	Mild edema	Edema grave	-	-
NESTOR, JR., et al. 1988	1-5	-	No edema	Mild edema	Moderate edema	Severe edema	Very severe edema
BALMER <sup>2</sup> et al. 2019	0-3	No edema	Mild edema	Moderate edema	Severe edema	-	-

For Nestor et al. (1988), udder edema occurs due to the retention of interstitial fluids in the intercellular space of the udder, which generates, according to the severity of clinical cases, different degrees of inflammation. It is possible to observe mild signs such as only edema, but more severe cases present the five cardinal signs of inflammation. This fact predisposes the development of lesions in the mammary parenchyma, also presenting a correlation with secondary diseases, such as mastitis.

The same author used the udder edema severity classification system presented by Swett et al. (1938), which quantifies udder edema in cattle in different ways. It is believed that Schmidt et al. (1959) and Randall et al. (1974), have used the same database as Nestor et al. (1988), considering what was presented by Swett et al. (1938).

According to the aforementioned authors, the classification of udder edema depends on a carefully performed visual assessment and palpation for subsequent score analysis. These classification scores include: udder edema, with a small increase in glandular volume (grade 1); edema with more significant proportions, reducing the visualization of the medial ligament of the udder (grade 2); significant edema in the mammary gland region, extending slightly to the umbilical region (grade 3); edema of the udder and umbilical region, demonstrating discomfort in locomotion correlated with pain, in addition to pronounced redness (grade 4); and extreme distortion of the udder and umbilicus, difficulties in locomotion and intense presence of the five cardinal signs of inflammation (grade 5).

For Morrison et al. (2018), a score of 0 was considered as a healthy animal that did not present any alteration in the mammary gland that was suggestive of udder edema. Scores 1, 2 and 3, that is, mild, moderate, and severe, respectively, had specific characteristics highlighted by the author. The mild degree (score 1) was described as an alteration that reduced the notoriety of the medial suspensory ligament, with slightly enlarged mammary quarters. The moderate degree (score 2) was described as preventing the appearance of the medial suspensory ligament, beginning to extend towards the front of the udder, and even accumulating near the umbilicus. The severe degree (score 3) was described as well-pronounced without signs of the medial suspensory ligament, extending towards the vulva and greater accumulation towards the umbilicus.

Balmer et al. (2018) and Balmer et al. (2019) carried out their research with a visual and ultrasonographic evaluation of the udders of cows, performing the compilation of data to prove the safety of the methods. The udder edema analyses had as a classification standard the following parameters: impression of the median suspensory ligament cleft, teat shape, udder shape, bulging of the subcutaneous veins and udder shape abnormalities. It was proven by

research that combined ultrasound and visual scores had a positive result regarding the safety of the diagnosis.

To classify the ultrasound images, a four-degree scoring system was used by Balmer et al. (2018) and Balmer et al. (2019), being presented as follows: score 0 = no edema, 1 = mild edema, 2 = moderate edema and 3 = severe edema. Signs of mild distension, with a small change in size, leaving the udder ligaments notable and without edema in the umbilical region characterized a mild case (grade 1); moderate distension with discomfort and mild cardinal signs of inflammation, discomfort in locomotion and reduction in the division of the udder ligaments characterized an intermediate case (grade 2); intense presence of acute inflammation with the notorious presence of the five cardinal signs of inflammation, difficulty in walking and maximum distention of the mammary quarters, preventing the visualization of udder ligaments, characterized a severe case (grade 3).

#### **4 CONCLUSION**

It is concluded that the most practical way to classify a case of udder edema is through the four-level classification system (0, 1, 2 and 3), in which degree 0 represents the absence of udder edema; grade 1 - the reduced presence of udder edema; grade 2 - discomfort in locomotion, mild signs of inflammation with significant edema in the udder region that is less evident in the umbilical region; and grade 3 - locomotive difficulties accompanied by massive edema of the udder and umbilical region, making it possible to identify the five cardinal signs of inflammation.



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