

VOL VI

# Estudos em Ciências Agrárias e Ambientais

Eduardo Spers  
(Organizador)



EDITORA  
ARTEMIS

2026

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## PRÓLOGO

O volume VI da coletânea *Estudos em Ciências Agrárias e Ambientais* reúne um conjunto de trabalhos que evidenciam a diversidade e a complexidade das investigações contemporâneas no campo agrário e ambiental, articulando perspectivas que vão desde a gestão dos territórios até os sistemas produtivos e o cuidado com a saúde e o bem-estar animal.

Organizado em três eixos temáticos, o volume inicia com discussões voltadas ao meio ambiente, à sustentabilidade e às dinâmicas socioecológicas, contemplando estudos que abordam questões relacionadas à governança territorial, aos saberes locais, às estratégias de gestão ambiental e à conservação da fauna. As contribuições deste eixo evidenciam a importância da articulação entre conhecimento científico e práticas sociais na compreensão dos desafios ambientais contemporâneos, bem como na construção de respostas sustentáveis e na preservação da biodiversidade em diferentes contextos.

O segundo eixo, dedicado à produção agrária, aos sistemas produtivos e aos recursos naturais, reúne pesquisas que exploram aspectos fundamentais da produção agrícola, incluindo qualidade de sementes, rendimento de culturas, organização de sistemas produtivos e manejo fitossanitário. Os trabalhos destacam a relevância de abordagens técnicas e científicas para o fortalecimento da produção, ao mesmo tempo em que apontam para a necessidade de práticas mais sustentáveis e eficientes no uso dos recursos naturais.

Por fim, o eixo voltado à saúde, produção e bem-estar animal apresenta estudos que discutem aspectos sanitários, comportamentais e de manejo na produção pecuária. As investigações evidenciam a importância de integrar conhecimento científico, tecnologia e práticas de cuidado para garantir não apenas a produtividade, mas também o bem-estar dos animais e a sustentabilidade dos sistemas produtivos, reforçando a centralidade dessas dimensões na pecuária contemporânea.

Ao reunir essas diferentes perspectivas, este volume reafirma o caráter interdisciplinar das Ciências Agrárias e Ambientais e sua relevância para enfrentar os desafios atuais relacionados à produção, à conservação dos recursos naturais e à sustentabilidade. Trata-se de uma obra que contribui para o avanço do conhecimento científico e para o fortalecimento de práticas mais responsáveis e integradas no campo agrário e ambiental.

**Eduardo Eugênio Spers**

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## DISEASES OF HOOFS TO THE HOLSTEIN FRESIAN DAIRY CATTLE IN THE INTENSIVE FARM SYSTEM OF BREEDING

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### **MSc Ivanka Hadžić**

Association of Trimmers  
Care and Therapy of Cattle Foot of Serbia,  
Belgrade, Serbia  
<https://orcid.org/0009-0005-3032-0173>

### **Academician Prof Dr Ivan Pavlović**

Scientific Institute of Veterinary Medicine of  
Serbia, Belgrade, Serbia  
<https://orcid.org/0000-0003-4751-6760>

**ABSTRACT:** To the inevitable mistakes in animal care and breeding process come by applying new technologies in intensive dairy cattle production with the purpose to increase milk production to every cow. Conditions of keeping, feeding, and reproduction as important factors in the intensive production are just some of the weak points during the race to increase the profitability of every cow. The habitat, in which we breed and exploit dairy cattle, is a largely important factor of general condition of cattle. Indoor stables, concrete floor, and keeping cattle in a tied system significantly contribute to the development of various hoof diseases. The influence of feeding as well as typical diseases of dairy cattle is one

of the triggers of various hoof diseases, and genetic predisposition is also. This leads us to the conclusion that during the production process, one must pay attention to many factors. Hoof diseases are a big problem in modern intensive livestock production from a zootechnical aspects, animal health care and agricultural economics point of view. The most effective way to suppress diseases of hooves and to decrease the loss caused in conditions of intensive cattle production is measures and procedures for every person employed in cattle production. Curative eliminates problems in the diseased cattle, but it doesn't eliminate losses of a producee. Increased expenses of a treatment and a decrease in production are directly proportional to the prevalence of hoof diseases. After this research we had come to the conclusion that hoof diseases like: laminitis, dermatitis digitalis and dermatitis interdigitalis didn't have greater exceptions during four cycles of treatment of hooves and that it hasn't come to the significant improvement. Diseases like: rusterholz ulcer, panaritium, and fibrom (small percentage participation) have shown significant variation, which points to occasionally improvement in a herd condition, but not permanently, which is a characteristic of a non-serious approach in solving a problem, due to irresponsible behaviour of all employee structures at farms.

**KEYWORDS:** dairy cattle; hoof diseases; zoohigiene.

## 1. INTRODUCTION

Business entities that are part of industrial and agricultural production can ensure survival in the conditions of the market economy by constant efforts to maintain competitiveness among similar or the same producers. In this process, science finds new technological solutions and proposes them to the profession, which tries to ensure their proper application in practice. Efforts are being made to reduce production costs, increase its volume and raise the quality level of the production unit. Zootechnics and veterinary medicine have set the primary principles of modern intensive cattle production, so that now more important progress can be achieved by improving the secondary parts of the technological chain that have been neglected until now. Animal husbandry in Serbia has been a popular branch of agriculture since time immemorial, mainly conditioned by the geographical relief. Representation of livestock is based mainly on cattle breeding, pig breeding and sheep breeding. As a result of intensive production, the basic life needs of animals are often neglected in breeding, so for example animals are forced to stay in a closed space, often tied (milking necks of cattle) in one place with the impossibility of movement or in a very limited space, e.g. pigs for fattening, beef for fattening, etc., Only our sheep have the privilege to some extent of moving freely on pasture as a profitable way of rearing. The consequences of this way of keeping are justified: better monitoring of each individual, individual feeding according to the special needs of each individual, better health care, optimisation of production space, and breeding control.

The intensive way of breeding dairy cows in the Republic of Serbia still mostly involves the tethered way of keeping them in closed barns made of solid material. In recent times, which means the last 9 years, there has been a change in the organization of farms, the building of free-range barns, the introduction of new technologies in milk production, and therefore increased care for the well-being of animals that are being farmed, to which animal owners are forced by law (Law on Animal Welfare, Sl.Glasnik RS, No. 41/2009). New farms that were established after 2009 and in practice since 2013 must comply with the norms prescribed by the Animal Welfare Act, which relate to the architecture of animal housing, their health care (both of the animals themselves and of the facility they are in), adequate nutrition, reduction of stress due to animal manipulation, as well as humane methods of slaughter and euthanasia. Diseases of the feet and claws are a special problem in the breeding of purebred cows.

Occupying a high place in the profitability of a farm. The costs of treatment of bovine hoof disease have significantly burdened the calculation of cow's milk and beef production by individual producers and modern intensive cattle production. The costs arising from the

treatment of diseased locomotory throats are far greater than the treatment of any other farm disease symptomatic of dairy throats. In the case of leg disease, there is a decrease in throat productivity for an average of one month, as well as a decline in the general health picture. Food intake has decreased, and apathy has increased, mainly due to the pain the animal suffers. Maintaining hygiene is of great importance for the prevention of diseases, and neglecting and improper handling of animals leads to the spread of various diseases of the locomotor system.

They are often combined with agents of bacterial, viral and fungal aetiology, and the appearance of laminitis can be caused by irregular and inadequate nutrition, lack of minerals and vitamins. According to the way dairy cattle farms in the Republic of Serbia are kept, we can divide them into two basic groups: free keeping system and tied keeping system. In the free-holding system, the necks move freely inside the object, while in the tied holding system, the necks are, as the word itself says, tied in one place. In the Republic of Serbia, the most represented breed of cattle for milk production is the Holstein Friesian, and it is immediately followed by the combined type, i.e. the Simmental cattle breed, which is bred on smaller farms in order to maintain the continuity of the income stream (milk + meat).

The Holstein Friesian is today the leading dairy breed of cattle in the world. It was created in the USA in the seventies of the 19th century from imported about 8,000 heads of the black and white Friesian breed from the Netherlands, under conditions of very intensive nutrition and with the application of strict selection. In 1970, a significant import of Holstein heifers from the USA began in Serbia, and by 1978, a total of 3,100 head were imported. Also, the importation of seeds and bulls had a great impact on the then existing breeds in the country. Larger imports occurred again in 2005 and 2006, mainly from the Netherlands, so it is estimated that its share when it comes to cattle breeding in Serbia is around 15%. They are characterised by a strong constitution and solid build, with particularly well-attached udders. The Holstein Friesian breed belongs to the dairy type of large-framed cattle. The height of cows is 145 cm, and of bulls 150-160 cm. The body weight of cows is 650-700 kg, and that of bulls is 1100-1300 kg. The milk yield of Holstein Friesian cows in countries with developed cattle breeding exceeds 8,000 kg (L) in an average lactation. In Serbia, taking into account all HF cows, it can be estimated that their annual milk yield is about 6,000 kg with about 3.6% fat. Apart from food, good housing is also an important factor because they are sensitive and susceptible to diseases and infertility if optimal housing conditions do not exist. The production life when it comes to HF cows is usually 3-4 years, but it is significantly shortened with unfavourable feeding and housing conditions.

## 2. CATTLE BREEDING

Today, in industrial farming, there are two basic ways of breeding cows: tethered cows and free-range animals. On traditional farms, the tethered system is common, while modern farming implies a free-range system of breeding. Although there are differences in the way of breeding, there are common aspects that are identical and related to the farm facilities themselves.

The construction of barns must meet the biological and production characteristics of the animals being raised, ensure their well-being and provide all the conditions for successful production. Although there are differences related to the space for keeping and the like, which are standardised for large and small ruminants, in all cases there are basic standards that must be respected during their construction.

A barn in farm is a building for keeping livestock. Usually, it means a building divided by separate partitions for individual animals and livestock. Barns should be built on drained and slightly elevated terrain, so that they are protected from strong winds. Protective forest belts can be erected near the barns. The location of the barn should be near traffic connections for easier access. The exterior design of the barn varies significantly depending on the climate, building materials, historical period and cultural styles of architecture. Various building materials can be used for construction, such as brick or stone walls, wood and steel. It is also essential to comply with all the necessary technologies according to the climatic conditions in which the animals will live.

Preparing the site for the barn is one of the most important preparatory stages. It should be borne in mind that the location for such a structure must be flat. The floor should be warm and moisture-resistant to prevent the accumulation of liquid waste on its surface. For proper drainage of water, urine and manure, the floor is usually placed at a higher level than the ground with a slight slope of 1% to 3% towards the drainage system. In the case of cattle barns, too much slope should not be left, as this can negatively affect the limbs of the livestock and the reproductive function of the cows.

The walls are built of solid material, such as concrete, brick or composite materials, depending on the type and age of the animals. Modern three-layer sandwich panels are also an excellent option for building the walls of the barn because they contain mineral wool insulation. This material allows for the maintenance of optimal temperatures, providing warmth in the winter and preventing excessive heat in the summer months. The roofs of barns are usually built of wooden structures and are usually sloping, under which a ceiling can be made for storing hay or equipment for caring for animals.

Classic barns for dairy and fattening cattle are designed so that the animals are arranged in two rows, with their heads facing the respective walls or with their heads facing each other. In the first case, there is a corridor in the middle of the barn with a width of 150 to 180 cm, which serves to remove manure and bring in bedding, while there are two narrower corridors (70-100 cm) next to the walls for distributing feed. In the second case, there is a corridor in the middle for distributing feed, and there are two corridors next to the walls for manure removal. Cattle beds usually have an average length of about 2.10 m, but can be shorter (1.70 m) or longer (2.5 m), with a width of 1 to 1.30 m, depending on the size of the animals.

## 2.1. TIED CATTLE BREEDING SYSTEM

In the tied system, the cow is limited to a precisely defined and relatively small space. Individual functions are determined in the narrowest space (feeding, lying down, milking the cow and cleaning the bed), a large share of transport work to bring food, bedding, and thermal insulation of the building should be satisfactory. Each cow can be observed individually.

The tied system prevails in about 90% of most countries. This type of keeping of cows means that they are kept individually, so the feeding of the cows is also individual, most often determined according to the milk yield of the cow, as well as care, general assessment of the condition, i.e. the most favourable conditions for permanent high milk yield. In essence, this system is maintained only by farms that have a maximum of 10-20 cows, and rarely over 30-40 cows. The tied system of keeping cows has a number.

Tied cattle breeding system represents an object made of solid or semi-solid material, for housing animals where they are prevented from moving freely. Ties can be in the form of a chain or a strong rope, but they must have a safe buckle for quickly untying the animal in the event of an accident or breakdown. The animal spends most of its time on beds, so it must satisfy hydro and thermal insulation, comfort when lying down and feeding, and stability when standing. Beds are usually made of concrete, wood, or baked brick. Recently, the use of rubber and artificial materials has become more and more common. The width of the bed is usually made at 110 cm, while a width of 120 cm is recommended for larger breeds. Partitions are placed between the beds, which, as a rule, are bent pipes with a height of 80 to 90 cm. The length of the bed can be different with a drop of 1 to 2%, and in relation to that, we distinguish long, medium and short beds. The length of the long bed is 2.2 meters, and its advantage is that the cows have a lot of space, which is mostly found in older barns. It also has its drawbacks because dung is

mostly done when the animal moves forward, when it feeds, so that the dung falls on the last quarter of the bed. Cows lie in the feces with their udders, so hygiene is more difficult. Because of this, this type requires large amounts of mat and a lot of manual work, so it is not recommended. The middle bed is the most widespread type of bed; its length is between 1.7 and 1.9 meters.

There is a manger in front, and a fertilising channel behind. Animal droppings are performed directly in the fertilisation channel, so no large amount of mat is needed, less work is required, and hygiene is at a much higher level. The length of the short bed is 1.4 to 1.6 meters. It leaves a little space for the animal, and dung is done over the channel, but the rear part of the animal is also over the channel when lying down, so the udder gets dirty. A mat is not desirable because it leads to clogging of the fertilising channel.

## 2.2. FREE RANGE SYSTEM BREEDING

Modern farming implies free range system breeding. This posture system is the most natural way in which the throat is provided with freedom of movement. Cows have a larger number of places to lie down, so they can choose a free place to lie down on their own. Freedom of movement and separation of functions that force cows to get up and move more often is very important, because it positively affects the general state of health, throat condition, length of use and production results. This holding system reduces the amount of human work to a minimum because every work operation is automated. The free housing system is almost without exception used for all larger herds starting from 10-20 cows and onwards. The main function of the cross tubes is to prevent the cow from going too deep on the bed, and at the same time, they make the cows learn to lie on the bed as correctly as possible. The transverse pipes also have the task of preventing the cows from standing on the bed, i.e. immediately after standing up, since they throw out the excrement, they pull back so that the excrement does not fall on the bed. The beds of this system can be high or low. High beds enable better hygiene maintenance, less work, but are more expensive. Low beds are cheaper but require more human labour due to the use of a mat. However, despite this circumstance, experts recommend using low beds more. The space for movement of cows in the barn should be large enough to allow unhindered movement of cows. This space should provide free access to places for feeding, going to the milking parlor and to the bed. The area of this space should be 3m<sup>2</sup> per cow. It is very difficult to meet the condition that the floor is not slippery and wet.

Deep matting is the cheapest and very simple way of keeping cows in stalls with deep matting. The basic characteristics of this method (system) of keeping are very large

quantities of mats of 8-10 kg per day per cow, and difficult maintenance of cow hygiene. Partitions between beds have a very important role because they should allow the legs to relax freely while lying down. The height of the partition is 80-100 cm, and it is very important that there are no sharp edges that could cause throat injuries.

Sloped floor barns are a new way of keeping cows in barns with a sloping floor. Stables with a sloping floor consist of two parts: a sleeping area and a feeding area. An important characteristic of a stable with a sloping floor is that the lying area has a slope of 5-10% - far less mats are used than with the previous method of keeping, because the mat is placed only at the top, which is well distributed and slowly moves downwards as the cow moves and lies down. The characteristics of deep mat and sloped floor cow housing are what allow the most natural way of cow housing.

### 3. NUTRITION OF HOLSTEIN FRIESIAN COWS

In order to achieve high milk yield in cows, it is necessary to determine the amount and content of daily rations. Excessive loading of the digestive tract with food adversely affects the course of digestion and the work of the heart and lungs, which can lead to various diseases. The amount of concentrated nutrients in the rations of dairy cows is determined based on their milk yield. If the milk yield of the cows is higher, the ration should be composed of a larger number of nutrients, including larger amounts of concentrates. The meal must satisfy the following criteria: that it is quantitatively sufficient, well-balanced, adequately chopped, neither too much nor too little, tasty and free of harmful impurities, with as little variation as possible in the composition of the meal. You should switch to a new type of food gradually, for a minimum of 7 days, because of the microflora of the rumen. Cows are fed at least as many times as they are milked at the same time.

The meal for cows should meet the needs for maintaining basic life functions (sustenance needs) and the needs for milk production. Depending on the production of milk and body mass (TM), up to 55% of energy is spent on maintenance needs. High milk production is not possible without adequate nutrition. For 1 kg of milk, a cow should consume at least 0.5 kg of dry matter (DM) - below that, problems arise in metabolism. Concentrated nutrients should not make up more than 60% of the ration.

#### 3.1. NUTRITION OF COWS IN EARLY LACTATION (60-70 DAYS AFTER CALVING)

In the early stage of lactation (up to the 8th week), maximum milk production is achieved. The consumption of energy for the production of milk exceeds the amount of energy that the cow can take in with food, so that the so-called negative energy balance.

The consequences can be a thinning of the throat and a later entry into estrus. With good nutrition, the negative balance is corrected after 4 weeks. In the first days after calving, the diet is the same as before calving - the best quality hay and less than 3.5 kg of concentrate. After that, succulent nutrients (green mass, silage) are introduced, and the concentrate is increased by 0.5 kg/day until the desired amount is reached. After 15 days, advancing (increasing the concentrate) is carried out so as to ensure a higher production of milk by 3-5 kg compared to the beginning of advancing. This is done as long as the cow reacts by increasing milk yield, and then for 3-7 days, the same level of nutrition. After that, the concentrate is matched with milk production. This period is the most sensitive as far as nutrition is concerned, and it mostly depends on how the entire lactation will be. In the period of early lactation, obese cows may develop metabolic diseases such as ketosis, a disorder of carbohydrate metabolism. Ketosis occurs when fat reserves from the body are melted - broken down and ketone bodies are created, which accumulate in the blood, and the body is unable to remove them. Then there is a decrease in appetite and an increase in blood glucose.

### 3.2. MEDIUM LACTATION (70-140 DAYS AFTER CALVING)

In this period, maximum food consumption is reached 2-4 weeks after maximum milk production. The cow does not lose weight but maintains it or increases it. The amount of milk depends directly on the quantity and quality of nutrition. The maximum share of concentrate in the SM meal should be up to 60%. Larger amounts than this would lead to acidosis, indigestion and a decrease in milk fat content.

### 3.3. LATE LACTATION (140-305 DAYS AFTER CALVING)

Milk production is declining at a rate of 8-10% per month. The cow is pregnant during that period. Young cows should receive additional amounts of feed during that period because they are still growing. This period is optimal for improving the condition of the cows. The creation of body reserves is achieved without major metabolic problems or disorders (fatty degeneration of the liver and the like). At the end of this period, the cow is dried, i.e. abolition of one milking and reduction of meals.

### 3.4. FEEDING OF DRY COWS

Proper nutrition during drying can significantly increase milk production in the next lactation, then the possibility of metabolic problems during and after calving is reduced. During this period, the nutrients from the meal are most efficiently used to increase the

weight of the fruit. In order to avoid fattening of cows, it is recommended to give coarse feed of less nutritional value (wheat straw, meadow hay). About 2 weeks before calving, it is necessary to start giving concentrate that will be used during lactation. It is necessary to add other nutrients that are normally used during lactation, but not during drying. On the day of calving, the cow's appetite decreases significantly, and then only a little hay and bran are given, and water is limited. When the delivery is normal, the cow recovers quickly, so in the following days her diet enters the consolidation phase.

During our monitoring of the health status of cattle on farms, we observed a correlation between the influence of hoof disease on production results and concluded that they are of exceptional importance for the health and well-being of cattle on farms. To that end, we started our research aimed at:

- To investigate which leg and hoof diseases appear in the intensive way of keeping the Holstein Friesian (HF) breed of cows.
- To investigate the effect of previous hoof therapy of HF breeds dairy cows on the recurrence of the same diseases.
- To examine and correlate the influence of nutrition, hygiene and housing of high-milk cattle on the occurrence of diseases of the locomotor system of the HF cow breed.
- To examine and compare the % increase/decrease in the number of throats suffering from locomotor system diseases.
- To determine the prevalence within each farm as well as within the total population.
- To determine the incidence during four cycles of hoof processing on all seven farms and on each farm individually.
- To determine the mean value, variability, and the coefficient of variation of all examined paw diseases.

#### **4. RESEARCH OF HOOF DISEASE IN FARM BREEDING**

When researching hoof diseases in high-milk cows of the HF breed in an intensive way of keeping, data collected from seven farms of Agriculture Corporation (AC) near Belgrade were used. Data collection and processing were performed by a technologist for the processing of clows. Hoof processing and natural records of hoof processing and therapy were carried out by 12 workers employed in hoof care and hoof processing of AC. The data used in this research refer to a period of two years, 2022 and 2023, that is, they

include a period of four regular cycles of hoof processing and care at AC Belgrade. The number of treated cows in that period is 37,893.

The research did not include leg diseases such as arthritis, peri-arthritis, limb deformities (congenital or acquired), dislocations, fractures, and sprains of the limbs.

The research includes hoof diseases of bacterial, viral, and fungal etiology, as well as hoof diseases due to disorders of metabolic processes within the body, mechanical injuries and professional errors during hoof processing. Hoof care is extremely important in modern intensive cattle breeding. Highly productive cows generally move very little, so their hooves grow too large, which leads to serious diseases. That is why constant care of the hooves is necessary, which consists in constant maintenance of hygienic conditions and occasional but regular trimming of overgrown hooves.

The processing of the hooves was performed on average twice a year, with the fact that individual recuperative hooves underwent the treatment more than once, and are included in the total number of treated (third treated) hooves.

Hoof processing using the Dutch method (Raven's method) in 9,000 cows and heifers of the HF breed of the AC is performed by the Department for Functional Hoof Processing at the AC Animal Husbandry Centre. This department was formed in 2007 as an innovation in the technological process of modern cattle breeding and investments aimed at reducing production costs. AC Corporation employs 12 direct executors with an international certificate issued by eminent international experts in the field.

Functional processing of hooves takes place in three segments. Regular trimming and shortening of hooves to a functional length, control and therapy of diagnosed diseases and measures to prevent hoof diseases. It is known that the hooves grow on average 0.5-0.8 cm per month, thus arriving at the calculation that the optimal time is around 6 months for a preventive hooves inspection and shortening to a functional length. Regular hooves treatment prevents certain diseases, cures existing ones, improves the general condition of the animal and increases milk production, from 5% to 35%.

The functional length of the hooves in adult female cows is 7.5 - 8.0 cm, measured from the edge of the coronary band. The height of the hoof should be on average 0.5 cm, and the angle between the front part of the hoof and the sole should be 45° - 50°.

#### 4.1. HOOF TRIMMING

Hoof trimming is performed by a trained technician or other professional with adequate knowledge of hoof trimming. It is performed in five stages, as follows:

1. Correction of the inner hoof of the hind legs in terms of length, thickness and height (front legs: correction of the outer hoofs).
2. Correction of the outer hoof of the hind legs, equalising in length, thickness and height with the inner hoof
3. Creating a hollow profile of the inner and outer hoof with relief of the main pressure points
4. Control and correction of the lower surface of the damaged hoof and the color of the deviating parts of the hoof horn.
5. Removal of loose horn.

\* Visual inspection of the interphalangeal space as well as the phalangeal, carpal and tarsal joints.

If there is a need for parenteral antibiotic treatment, the hoof trimmer indicates this to the prescribing veterinarian, who makes the decision whether to apply or just stick with the therapy with a topical antibiotic spray.

### **Tools and auxiliary materials for hoof trimming**

When processing hooves, it is necessary to have the appropriate tools and auxiliary equipment. The tools include:

1. **Grinder** - with an appropriate grinding plate intended for processing hooves, which can be:
  - with 3 to 7 blades on it; due to the high number of revolutions, the blades peel off excess horn in the form of thin flakes, without creating unnecessary dust. It is recommended for professional hoof processing workers, due to the comfort of use and the speed with which the desired results are achieved
  - Ground plate (finer or coarser fineness): a plate that files the horn and is recommended for beginners, for safer handling and reduced chances of injury to both the worker and the animal itself. However, improper handling can lead to burns to the sole of the hoof.
2. **Pliers for correcting hooves and claws**
3. **Reiser knives:** single-sided or double-sided; universal or single-sided for left and right hands
4. **Hoof ruler**, which determines the length, height and angle of the hoof before cutting
5. **Box for fixing the animal:** There are several types of fixing boxes, but the basic division is into walk-through and tilting.

In walk-through boxes, the animal is introduced into the box and at that time the head is fixed first, then the body with a wider belt that goes under the chest and another belt in front of the hind legs (to prevent uncontrolled falling and injury to the animal), then the legs that are being treated are fixed, according to the diagonal principle (front left - back right and vice versa). There are also several types of walk-through boxes, and this further depends on the colour of the throat that needs to be treated.

For smaller groups of animals, manual or semi-automatic boxes can be used in which the limbs are lifted manually or with a hydraulic lift, but the animal is fixed solely by the worker who does it. The maximum throughput of this type of box is about +/- 50 animals per day.

In automatic boxes, which are mainly used on large farms, the complete system of tying the animal, fixing the limbs and lifting them is carried out hydraulically. For such a box, one worker who processes the hooves is sufficient, without the need for service by auxiliary workers. The throughput of this type of box is about +/- 300 animals per day. The disadvantage of these types of boxes is that when introducing them into the box and fixing the head, the brachial nerve can be pressed, causing temporary or permanent paralysis of the animal. Such situations can be prevented by placing round tubes on the fixing part or wrapping the existing fixators with soft material.

In the case of tilting boxes, the animal is brought to the wall of the box, fixed there with the first belt across the chest - behind the front legs and the second belt in front of the rear legs, and then with a hydraulic lever it is brought into a lying position where all four extremities are fixed at once and accessible to the worker who processes them. The throughput of this type of box is about +/- 50 heads per day. The disadvantage of this type of box is that the animal is brought into a horizontal position, which can very easily lead to rumen dislocation, as well as the fact that the angle of the hoof during processing is changed to the physiological one, and that a less experienced worker can very easily make a mistake when processing the hoof.

Of course, the figures presented regarding the throughput capacity of the boxes refer to trimming the hoofs without additional major complications (such as amputation of the phalanges, or complicated Rusterholz ulcers, as well as in appropriate weather conditions)

- 6. Auxiliary materials** are all those tools that are used to successfully complete the intervention after hoof treatment, such as: bandages (bandage and cotton), gauze, cotton wool, blocks (wooden, plastic, rubber or foam), ATB spray (or other adequate types of medication intended exclusively for external use), ointments, creams or powders for rapid and aseptic wound healing. The

equipment that a hoof processing worker must have includes a protective suit, apron, gloves, as well as a visor or glasses. Protective footwear with reinforced toe caps is also mandatory in order to reduce the possibility of injuries during work.

## 5. STATISTICAL METHODS APPLIED DURING DATA PROCESSING

- Variance  $s^2 = \frac{\sum(X_i - \bar{X})}{n - 1}$  is used for statistical inference
- Standard deviation  $S = \sqrt{s^2} = \sqrt{\frac{\sum(X_i - \bar{X})}{n - 1}}$  for the sample, regardless of the purpose of use
- Coefficient of variation  $CV = \frac{S}{\bar{X}} \times 100$ 
  - o  $\bar{X}$  arithmetic mean

Variance and standard deviation are directly related because variance is the square root of the standard deviation, and standard deviation is the square root of the variance. Like the mean, they are used on data that are at the interval or ratio level of measurement.

Variance and standard deviation are used in inferential statistics.

The formal definition of variance is that it is the average of the squares of the differences between scores and the mean. From the definition, it follows that when calculating variance, the difference of each score from the mean is first calculated, then the difference is squared, and the squared difference is divided by the number of scores in the distribution.

Variance and standard deviation are sensitive to extreme values because they are based on the distance of individual scores from the mean.

- Cumulative incidence (CI) (absolute risk, incidence risk, incidence) represents the probability that healthy animals at the beginning of the monitoring period will become ill during that period, and is calculated as the number of new cases in a given period divided by the size of the susceptible population (population at risk) at the beginning of the monitoring. Cumulative incidence represents a share/proportion, so it has no unit.

$$CI = \frac{\text{number of new cases in a certain period of time}}{\text{No. susceptible to the disease at the beginning of the monitoring period}} \times 10n$$

- Prevalence can be measured over a certain period, PP (periodic prevalence). Prevalence is an important indicator that has found application in the organisation of health services (funds for treatment costs, hospital accommodation capacities, etc.)

$$PP = \frac{\sum \text{number of diseases in a certain period of time}}{\text{the entire population in the middle of the period}}$$

## 6. RESEARCH RESULTS

### 6.1. HOOF DISEASES

Hoof diseases represent a major problem of modern intensive cattle production from the aspects of animal husbandry and animal health care. Among them, bacterial diseases have a significant place. One of them is foot rot, also known as foul-in-the-foot, interdigital necrobacillosis or infectious pododermatitis. As the name suggests, it rots away the foot of the animal, more specifically, the area between the two toes of the affected animal. It is extremely painful and contagious. It can be treated with a series of medications, but if not treated, the whole herd can become infected.

#### 6.1.1. Infectious Hoof Lesions

The cause of the infection in cattle is anaerobic bacteria *Fusobacterium necrophorumnecrophorum*, *Dichelobacter nodosus*, *Trueperella pyogenes*, *Porphyromonas levii*, and *Prevotella intermedia*.

The bacteria normally are normally present in the GI system of cattle and, as a result, are also found in the animal's environment. These bacteria invade through a breach in the interdigital skin and then work synergistically to cause inflammation and necrosis of the soft tissues in the lower leg. The first sign of a foot-rot infection is when the skin between the claws of the hoof begins to swell (cellulitis). Swelling usually appears 24 hours after infection. The skin between the toes may be very red and tender and the toes may separate because of all the swelling. This is very painful to the animal and can cause lameness. The animal may also have a raised body temperature. A crack can develop along the infected part and is yellow in colour. The foot will have a foul odour. Tendons and joints in the area can become infected, which is much harder to treat. A condition known as "super foot rot" is seen in some animals. Superfoot rot infection occurs much faster and is usually much more severe.

### 6.1.1.1. Digital Dermatitis

Digital dermatitis is an infectious condition of the skin that commonly occurs in the interdigital cleft of the foot.

When the skin of a cow's foot is damaged by mechanical irritation and maceration by water and chemicals, a synergistic group of bacteria can invade the compromised skin barrier and create acute inflammation and infection of the dermis and epidermis. These bacteria are common in the environment and normally live in the rumen. The fact that digital dermatitis is not present on all farms suggests that more virulent strains of these bacteria are present on some farms. *Treponema* spp are a necessary component of this group of bacteria for generating disease. *Treponema* spp are gram-negative spirochetes that are microaerophilic and can encyst to protect themselves. As the bacteria invade the epidermis and damage the different layers, the body responds with a local inflammatory process that can result in hyperkeratosis and proliferative lesions.

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Digital dermatitis presents in a variety of stages, ranging from painful, bright red, ulcerated skin lesions to less painful, gray-black, circular, granulomatous skin lesions.

Edges can have a white margin and/or “hairs” protruding from them. Lesions are clearly demarcated and are typically located in the interdigital cleft; they can also occur at other locations, such as in the interdigital space or at the front of the foot. Severe lesions can become either proliferative with filamentous projections or hyperkeratotic. For practical purposes, it is useful to classify lesions as active (painful and ulcerative lesions > 2 cm) or chronic (gray-black hyperkeratotic lesions without painful ulcerative lesions > 2 cm).

#### 6.1.1.2. Mortellaro's Disease

Dermatitis digitalis (Mortellaro's disease) is a bacterial infection that causes ulcerative inflammation of the skin in the area above the hind hoof and, less commonly, above the interphalangeal space of the fore hoof. It was first described by Cheli and Mortellaro in 1974 in Italy.

The observed changes characteristic of dermatitis digitalis are: inflammation of the superficial layers of the skin, increased redness up to 10 cm in diameter, coarse, long and bristly hair, pustular changes that look like strawberries or raspberries with the secretion of an unpleasant odour (Hadžić I. et al., 2016).

An extremely contagious disease of the hoof of cattle of multicausal etiology.

#### 6.1.1.3. Foot Rot In Cattle

Foot rot is recognised by the sudden onset of lameness, accompanied by symmetrical swelling of the lower leg above the hoof. It can present in an outbreak at the herd level as a result of the sudden exposure to a risk factor for the disease. Depending on the stage of the disease, the interdigital skin splits open, and a foul-smelling discharge is noticeable. In more severe cases, loose pieces of necrotic tissue can be easily removed from the interdigital space.

Foot rot is a sporadic infection of the soft tissues of the foot in dairy and beef cattle, creating a sudden onset of mild to severe lameness.

The most common bacteria associated with foot rot are *Fusobacterium necrophorum*, *Dichelobacter nodosus*, *Trueperella pyogenes*, *Porphyromonas levii*, and *Prevotella intermedia*. They are all gram-negative anaerobes that are present in the GI system of cattle and, as a result, are also found in the animal's environment. These bacteria invade through a breach in the interdigital skin and then work synergistically to cause inflammation and necrosis of the soft tissues in the lower leg.

The key focus to prevent foot rot is to prevent skin damage, thereby removing the opportunity for bacterial infection. Skin damage, typically of mechanical origin, results

from contact with rocks, sharp edges, cables, and other hazardous objects or protrusions in the animal's housing environment. Skin damage can also result from chronic wetting of the foot in muddy or wet and dirty environments. On dairy farms, the use of foot baths with a range of disinfectants is an aid to clean and disinfect the interdigital skin. Currently, no pharmaceutical products are labelled with a claim to prevent foot rot.

#### 6.1.1.4. Septic Inflammation Of The Foot Corio (*Pododermatitis septica*)

The cause of the disease is penetration of the causative agents of suppuration and necrosis through the damaged horn to the corium. There, they multiply in an ideal environment, causing the described inflammation with the destruction of the corium layers to a greater or lesser extent. In the advanced stage, the corium separates from the horn.

Recognition of lameness of a medium to high degree. At the beginning of the disease, the changes are insignificant, or there are no visible changes, and later redness with tempering appears in the crown edge and in the area of the pad. Sensitivity to pressure occurs.

The course of the disease is spread and flare-ups of the inflammation if the cause of the disease is not eliminated.

Therapy (treatment): Opening the focus of inflammation, and removing the damaged horn, i.e. the horn that is separated from the corium. The diseased area is relieved with hoof treatment, placing a block (knob) or bandage when necessary.

#### 6.1.1.5. RUSTERHOLZ'S ULCER (Chronic limited (circumscript) purulent-necrotic inflammation of the medial plantar part of the corium)

Rusterholz's ulcer is the occurrence of a chronic limited ulcer of the medial plantar part of the corium due to stretching of the deep flexor tendon, caused by the incorrect posture of the animal, inadequate, too short beds, as well as inadequate and unprofessional hoof treatment (Hadžić I. et al., 2014).

Rusterholz's ulcer mainly affects animals older than 30 months. The occurrence of Rusterholz's ulcer as a consequence of chronic laminitis is manifested by a disorder of limb posture, an incorrect position of the spinal column due to difficult movement caused by pain in the hoof area.

Despite the severe clinical picture of the affected animal, the course and prognosis are in most cases favorable if the correct method and adequate therapy are applied by a professional and trained person.

#### 6.1.1.6. Heel Erosion Or Stinky Foot (*dermatitis interdigitalis*)

Dermatitis interdigitalis is a bacterial inflammation of the heel and the skin between the two toes and the area of the pads, very similar to dermatitis digitalis, from which it is distinguished only by the location of the lesions (Metzner, 2001). In previous years, dermatitis interdigitalis was the most common hoof disease problem in the region (Zemljič, 2007).

Cracks are formed, where later a surface exudate is formed, separated by erosions in the interphalangeal space towards the pads. Uneven and excessive growth of the horn with the formation of folds in the area of the pads leads to the beginning of incorrect loading, later to contusion of the corium and finally to lameness (Hadžić I. et al., 2013).

The decomposition of necrotic tissue produces an extremely unpleasant odour, which is why this disease is also known as “Stinky foot” and “Heel erosion”

### 6.1.2. NONINFECTIOUS HOOF LESIONS

Noninfectious hoof lesions in cattle are non-contagious structural, environmental, or metabolic failures of the claw horn, including sole ulcers, white line disease, and haemorrhages. Primarily caused by nutritional, environmental (slurry/concrete), or mechanical stress, these lesions often cause significant pain, lameness, and reduced fertility.

#### 6.1.2.1. Laminitis (*Pododermatitis aseptica diffusa*):

Laminitis, as a disease, is based on a disorder of the microcirculation of the vascular network of the corium, which leads to irregular growth of the horn and its poor quality. Pododermatitis aseptica diffusa occurs in most cases in several places at the same time.

The cause of the disease is improper and inadequate nutrition, as well as/or poor components within the feed. Local consequences, severity of the disease and development may differ from case to case:

**Acute lameness:** A sudden onset of severe lameness with signs of severe pain, causing the cows to be unable to move and mostly lie down. There are no visible changes to the hooves, but they have hot (temperate) legs and strong pulsation of the blood vessels in the lower parts of the legs. There is swelling of the coronal edge, and when the hoof is pressed with forceps, the animal reacts with a clear defensive reaction. Significance: relatively rare, clear symptoms, mostly a problem of one animal

**Subacute lameness:** There are no external visible symptoms, but a slight change in the horn is observed on the hooves in the area of the white line, from yellowish to reddish

in color, which indicates the disease. The horn is brittle and brittle. Affected animals rarely show pronounced lameness, but walk stiffly, and mostly lie down without clear signs of the disease. Significance: Occurs frequently, economically significant

**Chronic lameness:** Very pronounced changes in the front part of the hoof wall (horn rings and deep grooves between them) with a widened hoof in the area of the white line. These changes in the horn do not lead to lameness, but additional diseases such as ulcers and inflammation of the corium, if they last longer, can lead to the lowering or rotation of the metatarsal bone. Significance: Occurs frequently, economically significant, the problem is the entire foot.

#### 6.1.2.2. Sole Hemorrhages In Cattle

Sole haemorrhages typically occur beneath the flexor tuberosity of the third phalanx (P3) or along the white line; they can also occur on any part of the weight-bearing surface of the hoof. The lameness associated with a sole haemorrhage varies in relation to the time since onset and the size of the haemorrhage. Sole haemorrhages should be thought of as precursors to more severe hoof lesions, such as sole ulcers.

Sole haemorrhages result from the pressure of P3 on the corium. This pressure is a consequence of changes in the suspending and supporting structures that are due to mechanical and or metabolic processes. As a result of the pressure, the corium leaks blood into keratinocytes at the dermal-epidermal interface. The timing and amount of pressure determine the amount of haemorrhage visible on the hoof. Extended periods of pressure lead to more severe hoof lesions, such as sole ulcers and white line disease. Sole haemorrhages present as red, yellow, blue, and/or purple discoloration of the hoof horn.

Cows with a sole haemorrhage may or may not show clinical signs of lameness at the time of diagnosis. This inconsistency in lameness is due to the inherent lag between the development of a sole haemorrhage and the visibility of this hemorrhage on the sole surface. Sole haemorrhages can be an incidental finding at the time of hoof trimming. In addition, cows with a history of lameness may present with sole haemorrhage at the site of their previous lesions.

#### 6.1.2.3. Sole Ulcers In Cattle

Sole ulcers are damaged or penetrated areas of the sole horn due to increased pressure and repeated compression of the corium. They commonly occur beneath the flexor tuberosity of P3. They are associated with varying amounts of pain and resulting changes in weight-bearing.

In their early stages, sole ulcers and sole haemorrhages share a common pathogenesis. Sole ulcers develop as a result of continuous pressure by the flexor tuberosity of P3 on the corium. This pressure, triggered by movement and sinking of P3, leads to changes and weakening of the suspending and supporting structures of P3 because of mechanical, hormonal, and/or metabolic processes. As a result of this pressure, the corium initially leaks blood into keratinocytes at the dermal-epidermal interface (resulting in the haemorrhage). Over time, the pressure from P3 leads to the destruction of keratinocytes and the interruption of horn growth, causing the corium to protrude through the horn defect. The pressure on the corium also initiates an inflammatory pathway, resulting in long-term structural changes to P3 and the corium.

#### 6.1.2.4. White Line Disease In Cattle

The term white line disease encompasses a range of lesions (haemorrhages, fissures, separations, abscesses) that occur in the white line region.

The exact cause of white line lesions is unclear. The white line is made up of three different types of horn, all of which are weaker than the wall and sole horn. Currently, the pathogenesis of white line disease is thought to be similar to that described for sole ulcers, in which P3's suspensory mechanisms are compromised, resulting in damage to the keratinocytes that grow white line horn. Internal and external traumatic forces generate a shearing action at the white line that can cause hoof wall separation. These gaps can allow the entry of bacteria and foreign bodies, resulting in damage to the corium and inflammatory changes to P3.

#### 6.1.2.5. Thin Soles In Cattle

Thin sole lesions occur when the sole horn has worn away enough that the sole flexes with digital pressure, but the corium is not exposed.

Lameness has long been one of the three major economic disorders, particularly in dairy cattle. Thin soles, excessive wear of the soles, are only one reason for lameness. Their occurrence varies from farm to farm. Outbreaks may occur on intensively managed dairy farms, particularly on pasture-based systems. However, the disorder has been recognised in housed dairy and feed-lotted beef cows. Typically, thin soles are seen in dairy cows in early lactation exposed to wet conditions at the claw level and long walking distances. Abrasive material/s on the walking surfaces and feeding platforms usually speed up the process of excessive wear. Excessive sole wear may be expected in new or re-concreted milking parlours and yards. The new concrete is very abrasive. In such situations, more

than half of the herd may develop lameness within a few weeks of exposure to the new/re-concreted area (popularly referred to as 'new concrete disease').

Early signs of thin soles include a slow, painful gait. The walking style is often described as 'walking on eggshells'. Milk production is lowered at the individual cow and group level. On clinical examination, the dorsal wall of the claw is short, and the sole is flexible on thumb pressure. Haemorrhages in all claw zones may be present. The incidence of sole ulcers, white line disease, toe ulcers, subsolar abscess and osteitis of the third phalanx is often increased. Control should aim to prevent excessive wear, early detection of the affected cows and improve the claw horn quality. This article discusses the thin sole disorder, not addressing that caused by over-trimming.

Thin soles can result from overtrimming or from excessive wear as a result of walking on an abrasive surface. Abrasive walking surfaces or bedding materials are typically necessary factors in thin sole development. These factors, combined with long walking distances or aggressive or poor handling practices, lead to slipping and increased wear of the sole. Another predisposing factor to increased wear of the sole is abrupt changes in the animal's walking surfaces, such as going from pasture or dirt lots to concrete flooring.

#### 6.1.2.6. Toe Ulcers And Toe Necrosis In Cattle

Toe ulcers and toe necrosis are sequelae of thin soles that cause severe lameness. The factors that result in toe ulcers and toe necrosis are similar to those that cause thin soles. Together, these toe lesions should be thought of as a continuum. Toe ulcers and toe necrosis develop because thin soles go undiagnosed or because the abrasion is so excessive that the thin-sole stage is very short. Once the corium is exposed, bacteria have an entry point and can proliferate. Furthermore, an inflammatory process develops as a result of bacterial invasion or the original traumatic process. Both the bacterial and inflammatory processes result in widespread damage to the corium that can eventually extend to parts of P3.

#### 6.1.2.7. CORKSCREW CLAW IN CATTLE

A corkscrew claw is a structural abnormality of the phalanges that occurs in both beef and dairy cattle. Historically, it occurred on the lateral hind hooves of older animals. but is now reported in medial hooves of both the front and back feet of younger animals as well.

The exact cause of corkscrew claws is unknown. Historically, the presentation in older animals was thought to have both genetic and environmental components. The newer development of corkscrew syndrome in younger animals seems to have more of an environmental component, because it appears to occur in specific situations. The anatomical changes present in corkscrew claws – such as rotation, bone remodelling, and narrowing of P3 – suggest that specific factors experienced during an animal's development lead to these changes. It is currently unclear whether the changes in P3 are the cause of external changes or the external changes occur first, followed by changes in P3.

Breed and growth rate have been associated with the development of corkscrew claws. Similarly, raising young animals in an environment that has lots of traction (eg, sand bedding), as well as competition or infrequent feed delivery in the feed bunk area, appears to increase the prevalence of corkscrew claw. All of these risk factors suggest that the pathogenesis is due to excessive rotational forces on P3 during periods of increased laxity in ligaments and tendons.

#### 6.1.2.8. Fissures In Cattle

Fissures form in the walls of hooves in both dairy and beef cattle and may cause lameness if they extend to the corium. Fissures are uncommon in most herds. By direction and location, they can be classified into horizontal, vertical, and axial wall fissures.

The pathogenesis of axial and vertical fissures is not well understood. Vertical wall fissures are more common in beef cattle housed in hot, dry, and sandy climates. Vitamin and mineral deficiencies are thought to be contributing factors because of their role in hoof horn development and integrity. Axial wall fissures are even less researched, although some association with digital dermatitis has been reported anecdotally. Horizontal fissures occur when a variety of severe metabolic or physiological events disrupts horn production. Because of the multiple segments that make up the wall, the grooves do not typically extend to the corium.

Horizontal and vertical fissures occur on the dorsal wall and can be identified without picking up the cow's foot. Vertical wall fissures are more common in the front feet of beef cattle on pasture and can originate from various locations, including the coronary band, toe, or the middle of the wall. Horizontal wall cracks typically occur on multiple hooves on the same animal at approximately the same location. When the horizontal wall crack approaches the toe area, it is likely to become separated from the underlying wall. Axial wall cracks extend from the sole to the coronary band on the axial wall.

#### 6.1.2.9. Deep Digital Sepsis In Cattle

Deep digital sepsis is an infection of the foot that involves the deeper structures, typically including the distal interphalangeal joint and flexor tendons. Deep sepsis can be an infrequent sequela to lesions such as foot rot, sole ulcers, and white line disease.

Deep digital sepsis is a sequela of other hoof lesions, such as foot rot, sole ulcers, white line disease, and, more rarely, puncture wounds. Delayed or inappropriate treatment of these lesions can increase the occurrence of deep sepsis. Deep digital sepsis occurs after the inflammation, bacterial contamination, and necrosis associated with these original hoof lesions have reached the distal interphalangeal joint, the deep flexor tendon, or other deeper structures, such as the navicular bursa. At this stage, normal treatments for the original lesions are ineffective, and the animal responds with a localised inflammatory response.

#### 6.1.2.10. Interdigital Hyperplasia In Cattle

Interdigital hyperplasia is the growth of fibrous tissue in the interdigital space of beef and dairy cattle.

The pathogenesis of interdigital hyperplasia is thought to be multifactorial, but it is not well understood. Chronic interdigital skin irritation is the primary factor; factors that contribute to this irritation are thought to include poor hygiene, hindered walking surfaces, and other infectious hoof lesions. In dairy herds, hyperplasia appears to be related to other infectious hoof lesions, such as foot rot and digital dermatitis. The irritation and bacteria that cause infectious hoof lesions can also cause hyperplasia of the skin cells. Another relevant factor is the strain exerted on interdigital ligaments by inappropriate hoof-trimming practices, abnormal conformation, or unstable walking surfaces; this strain is believed to predispose to interdigital hyperplasia.

#### 6.1.2.11. Papillomatous Dermatitis Digitalis (*dermatitis papillomatosis*)

Papillomatous dermatitis digitalis is the latest identified variety of digitalis dermatitis of cattle hoofs of multicausal etiology.

In the initial phase, there are small, thin white papillae with a velvety appearance, while in the advanced phase of the disease, the papillae can reach a length of over 10 cm and be visibly noticeable on the caudal side of the hoof. The papillae of the affected hoof are highly contagious, and careful handling of waste material and its harmless disposal are necessary.

The appearance of the papillae is accompanied by a colourless exudate with a very unpleasant odour.

#### 6.1.2.12. Swelling Between The Hooves (fibroma, limax, tiloma)

In the etiology of this disease, several causative agents have been identified so far, but none as primary. The disease occurs as a result of: inadequate substrate, positive genetic predisposition, pathogenic agents present in the environment (fusobacterium necrophorum), mechanical injuries, irritation of the interpalpary space and avitaminosis.

Fibroma is a hyperplasia of the skin of the interpalpatal space in the form of pale pink to dark gray and brown callus. The formation of calluses and hyperplastic formations on the skin of the interpalpatal space after chronic irritation of the interpalpatal tissue caused by various factors (Hadžić I. et al. 2014).

In the case of extremely large fibroids due to their positioning in the interpalatine space, luxation of one of the phalanges and their fracture is possible.

#### 6.1.2.13. PANARITIUM, leg rot, red leg, (*Necrosis interdigitalis*)

Panaritium is a purulent inflammation of the inter-hoof tissue of the heel and crown, occurring in a lighter (purulent) or more severe (necrotic) form of the hoof with the appearance of moderate swelling of the affected regions.

Several microorganisms, streptococci, staphylococci, clostridia and/or fungi, participate in the development of the disease.

Sudden onset of moderate to severe lameness. Temperate swelling of the heel and/or crown edge occurs, which spreads to involve the proximal extremities. The general condition is disturbed with a temperature often up to 41° C.

#### 6.1.2.14. OVERGROWN HOOF (Stable, forced, beaked, sickle, scissored)

The cause is insufficient, improper and unprofessional, or rarely (never) performed hoof care (treatment).

Overgrown hooves and improper loading of one or more hooves often occurs in a bound hoof system. Also with soft ground.

Animals are reluctant to walk, suffer pain and exhibit lameness. Overgrown claws also cause problems with ligaments and joints.

## 7. PREVALENCE OF HOOF DISEASE ON SEVEN EXAMINED FARMS

The test was carried out on seven AC Corporation farms in the period from 03.12.2022. until 08.12.2023. year during the regular treatment of clows, and on that occasion six paw diseases were diagnosed.

Table 1: Diagnosed hoof diseases

A	B	C	D	E	F	G	H	I	J	K
Circle Farm		I	II	I-II	III	II-III	IV	III-IV	I-IV	Σ
Farm 01	Dg.	Date 25.01.-05.03.2022	Date 01.08.-03.09.2022	%	Date 02.02.-10.03.2023	%	Date 09.08.-21.08.2023	%	%	
		Σ 1681	Σ 1708		Σ 1585		Σ 1706			Σ 6680
	L/Cl	1494	1584	4.35	1491	1.42	1529	-4.72	0.84	6098
		88,87%	92,74%		94,06%		89,62%			
	Rh/Cl	229	372	59.83	229	-33.65	458=26,84+ ps=489	98.48	110.43	1319
		13,62%	21,77%		14,44%		28,66%			
	DiD/Cl	1157	1053	-10.42	1127	15.33	1279	5.44	8.94	4616
		68,82%	61,65%		71,10%		74,97%			
	DD/Cl	227	442	91.63	471	14.84	478	-5.72	107.48	1618
		13,50%	25,87%		29,71%		28,01%			
	P/Cl	36	23	-37.38	21	-1.49	20	-11.36	-45.33	100
		2,14%	1,34%		1,32%		1,17%			
	F/Cl	81	136	85.49	76	-39.82	140	71.19	70.48	433
		4,81%	7,96%		4,79%		8,20%			
P.S.	x	x		x		31 = 1,81%				
Σ Blok	/	42		28		176 = 10,31%				
Circle		I	II		III		IV		I-VI	Σ

Farm 02	Dg.	Date 30.03-20.05.2022	Date 29.10.-17.11.2022	%	Date 13.05.-07.06.2023	%	Date 03.11.-08.12.2023	%	%	
		Σ 1725	Σ 1381		Σ 1277		Σ 1447			Σ 5830
	L/CI	1521	1240	1.84	1123	-2.06	1410	10.80	10.51	5294
		88,17%	89,79%		87,94%		97,44%			
	Rh/CI	199	321	101.56	308-24,11% +ps=345	16.48	435=30,06% +ps=484	23.53	190.03	1349
		11,53%	23,24%		27,07		33,44%			
	DiD/CI	1248	961	-3.81	974	9.61	872	-23.98	-16.69	4055
		72,34%	69,58%		76,27%		60,26%			
	DD/CI	287	389	69.33	399	10.94	664	46.86	175.89	1739
		16,63%	28,16%		31,24%		45,88%			
P/CI	18	13	-13.46	17	47.78	12	-38.35	-21.15	60	
	1,04%	0,9%		1,33%		0,82%				
F/CI	97	131	68.68	104	-14.14	132	12.04	62.27	464	
	5,62%	9,48%		8,14%		9,12%				
P.S.	x	x		37 = 2,89%		49 = 3,38%				
Σ Blok		29		118 = 9,24%		161 = 11,12%				
Circle		I	II		III		IV		I-VI	Σ
Farm 03	Dg.	Date 13.11.2009-21.01.2022	Date 19.05.-11.06.2022	%	Date 18.11.-13.12.2022	%	Date 06.06.-22.06.2023	%	%	
		Σ 1259	Σ 1179		Σ 1197		Σ 1246			Σ 4881
	L/CI	871	1094	34.13	1089	-1.96	1166	2.86	35.25	4220
		69,18%	92,79%		90,97%		93,57%			
	Rh/CI	268	168	-33.08	349	104.70	337=27,5 +ps=358	-1.44	35.01	1143
		21,28%	14,24%		29,15%		28,73%			
	DiD/CI	622	850	46.69	798	7.95	950	14.37	54.33	3220
		49,40%	72,42%		66,66%		76,24			
	DD/CI	601	275	-51.14	388	38.98	348	-13.85	-41.50	1612
		47,73%	23,32%		32,41%		27,92%			
P/CI	x	7		77	989.83	18	-77.60	144.07	102	
		0,59%		6,43%		1,44%				
F/CI	x	83		14	-84.45	108	646.55	16.08	205	
		7,46%		1,16%		8,66%				
P.S.	x			x		21 = 1,68%				
Σ Blok	3	2		118		131 = 10,51%				
Circle		I	II		III		IV		I-VI	Σ

Farm 04	Dg.	Date 03.12.2009-16.01.2022	Date 10.06.-05.07.2022	%	Date 14.12.-31.12.2022	%	Date 21.06.-14.07.2023	%	%	
		Σ 1273	Σ 1124		Σ 1157		Σ 1137			Σ 4691
	L/CI	1129	1112	2.69	1048	-0.55	1040	0.98	3.13	4329
		88,68%	91,07%		90,57%		91,46%			
	Rh/CI	241	128	-44.64	202	66.50	211=18,55% +ps=229	15.42	6.39	800
		18,93%	10,48%		17,45%		20,14%			
	DiD/CI	695	972	40.32	838	-5.46	800	-2.84	28.88	3305
		54,59%	76,60%		72,42%		70,36%			
	DD/CI	191	345	88.33	407	24.49	350	-12.48	105.2	1293
		15%	28,25%		35,17%		30,78%			
	P/CI	7	5	-25.92	61	121.75	7	-88.42	12.96	80
		0,54%	0,40%		5,27%		0,61%			
	F/CI	44	65	54.20	10	-83.83	55	461.62	40.0	174
		3,45%	5,32%		0,86%		4,83%			
P.S.	x	x		x		18 = 1,58%				
Σ Blok	x	9		39		72				

Circle		I	II		III		IV		I-VI	Σ
Farma 05	Dg.	Date 04.03.-29.03.2022	Date 04.09.-30.9.2022	%	Date 11.03.-07.04.2023	%	Date 20.09-17.10.2023	%	%	
		Σ 1531	Σ 1322		Σ 1321		Σ 1287			Σ 5461
	L/CI	1214	1177	12.28	1279	8.74	1242	-0.33	21.70	4912
		79,29%	89,03%		96,82%		96,5%			
	Rh/CI	205	404	128.32	264	-34.59	428=33,25% +ps=479	86.23	178.10	1352
		13,38%	30,55%		19,98%		37,21%			
	DiD/CI	960	775	-12.11	939	21.25	910	-0.53	5.99	3584
		66,70%	58,62%		71,08%		70,70%			
	DD/CI	509	542	23.31	441	-18.56	438	1.94	2.37	1930
		33,24%	40,99%		33,38%		34,03%			
	P/CI	30	25	-35.89	19	14.4	21	13.98	-16.41	95
		1,95%	1,25%		1,43%		1,63%			
	F/CI	212	125	-31.72	146	-3.80	203	73.48	13.94	686
		13,84%	9,45%		9,09%		15,77			
P.S.	x	x		x		51 = 3,96%				
Σ Blok	x	36		41		232 = 18,02%				
Circle		I	II		III		IV		I-VI	Σ

Fara 06	Dg.	Date 25.01.- 23.04.2022	Date 01.10.- 30.10.2022	%	Date 08.04.- 12.05.2023	%	Date 17.10.- 18.11.2022	%	%		
		Σ 1787	Σ 1319		Σ 1335		Σ 1405				Σ 5846
	L/CI	1399	1201	16.31	1200	-1.37	1344	6.51	22.19	5144	
		78,28%	91,05%		89,8%		95,65%				
	Rh/CI	221	420	157.60	236	-44.50	457=33,52% +ps=538	116.69	209.79	1415	
		12,36%	31,84%		17,67%		38,29%				
	DiD/CI	1118	840	-1.79	875	2.92	1029	11.73	17.05	3862	
		62,56%	63,68%		65,54%		73,23%				
	DD/CI	650	578	20.48	506	-13.50	547	2.71	7.03	2281	
		36,37%	43,82%		37,9%		38,93%				
P/CI	17	18	43.15	26	42.64	37	35.56	176.84	98		
	0,95%	1,36%		1,94%		2,63%					
F/CI	145	104	-2.83	135	28.29	82	28.09	59.68	466		
	8,11%	7,88%		10,11%		12,95%					
P.S.	x	x		x		81 = 5,76%					
Σ Blok	x	36		93=6,96%		219					

Circle		I	II		III		IV		I-VI	Σ
Fara 07	Dg.	Date 21.02- 22.02.2022	Date 06.07.- 31.07.2022	%	Date 31.12- 01.02.2023	%	Date 15.07- 17.08.2023	%	%	
		Σ 983	Σ 1097		Σ 1208		Σ 1216			Σ 4504
	L/CI	888	995	0.40	1208	10.25	1129	-7.16	2.77	4220
		90,33%	90,70%		100%		92,84%			
	Rh/CI	117	281	115.21	166	16.35	303=24,9% +ps330	97.45	127.98	894
		11,90%	25,61%		13,74%		27,13%			
	DiD/CI	804	699	-22.10	907	17.84	824	-9.75	-17.15	3234
		81,79%	63,71%		75,08%		67,76%			
	DD/CI	285	315	-0.96	434	25.04	310	-28.99	-12.07	1344
		28,99%	28,71%		35,9%		25,49%			
P/CI	7	54	592.95	9	-84.75	13	41.33	49.29	83	
	0,71%	4,92%		0,75%		1,06%				
F/CI	112	146	16.76	130	-19.09	247	88.75	78.31	635	
	11,39%	13,30%		10,76%		20,31%				
P.S.	x					27 = 2,22%				
Σ Blok	x	26		15		129				

Legend:

- Column A: represents the farm on which the hooves were processed

- Column B: represents the diagnosis of the disease
- Column C: represents hoof therapy I path
- Column D: represents hoof II treatment
- Column E: represents the percentage of disease increase/decrease compared to the first time
- Column F: represents hoof therapy III way
- Column G: represents the percentage of increase/decrease of the disease in relation to the II way
- Column H: represents hoof IV treatment
- Column I: represents the percentage of increase/decrease of the disease in relation to the III path
- Column J: represents the percentage of increase/decrease in diseases from I to IV.

From table 1, where, in addition to natural data, the percentages of increase/decrease of the disease during the four cycles of processing the clows are shown, we can conclude that: The percentage of increase/decrease of the disease by farms from the first to the fourth cycle of hoof processing moved as follows: during four cycles of hoof processing and therapy, farm F1 managed to maintain the percentage of laminitis occurrence at relatively the same level with an increase of 0.84%, while on the F3 farm that number increased by 35.25%. Rusterholz's ulcer recorded the highest increase on the F6 farm of 209.75%, while on the F4 the increase was only 6.39%. Dermatitis interdigitalis recorded the greatest increase on the F3 farm by 54.33%, while on the F7 farm it decreased by -17.16%. Dermatitis digitalis has the highest percentage of increase on the farm F4, and that is 175.89%, while its decrease was observed on the farm F3 of -41.50%. The reduction of Panaricium occurred on the F1 farm by -45.33%, while on the F6, there was an expansion of this disease by 176.84%. The number of throats affected by fibroma increased on farm F7 by 78.31%, while on F5 the increase was only by 13.94%.

Table 2: Total number of sick cows by diagnosis on seven farms.

A	B	C
	Σ 37893	100 %
L	34217	PP 90.29 %
Rh	8272	PP 21.82 %
Did	25876	PP 68.28 %
Dd	11817	PP 31.18 %
P	618	PP 1.63 %
F	3063	PP 8.08 %

Legend:

A. Disease diagnoses: L – laminitis; Rh - Rutterholz ulcer; Did - dermatitis interdigitalis; Dd - dermatitis digitalis; P – panaritiium; F - fibroma

B. Total number of treated heads (all seven farms)

C. Percentage of diseases in the entire zapat (all seven farms) PP (periodic prevalence)

In Table 2, we see the total and percentage share of the disease in the entire region. The percentage of periodic prevalence by diseases is for laminitis 90.29%, for Rusterholz's ulcer 21.82%, dermatitis interdigitalis 68.28%, dermatitis digitalis 31.18%, panaritium 1.63% and fibroma 8.08%

## 8. INFLUENCE OF PREVIOUS THERAPY ON THE RECURRENCE OF THE SAME HOOF DISEASES

Table 3. Diagnosed hoof diseases, variance, standard deviation and coefficient of variation.

	L		Rh		DiD	
	No	% TP	No	% TP	No	% TP
1	6098	91.29	1319	19.74	4616	69.1
2	5294	90.81	1349	23.14	4055	69.55
3	4220	86.46	1143	23.42	3220	65.97
4	4329	92.28	800	18.48	3305	76.35
5	4912	89.95	1352	24.76	3584	65.63
6	5144	87.99	1415	24.2	3862	66.06
7	4220	93.69	894	19.85	3234	71.8
$\Sigma$	34217	<b>PP 90.29</b>	8272	<b>PP 21.82</b>	25876	<b>PP 68.28</b>
	4888.14	90.35	1181.71	21.94	3696.57	69.21
min	4220	86.46	800	18.48	3220	65.63
max	6098	92.28	1415	24.76	4616	76.35
S <sup>2</sup>	483330.84	6.15	60039.7	6.3	268044.35	15.21
Sd	695.22	2.48	245.03	2.51	517.73	3.9
Cv	14.22%	2.75	20.74%	11.44	14%	5.63

	DD		P		F	
	No	% TP	No	% TP	No	% TP
1	1618	24.22	100	1.5	433	6.48
2	1739	29.83	60	1.03	464	7.96
3	1612	33.03	102	2.09	205	4.2
4	1293	27.56	80	1.85	174	4.02
5	1930	35.34	95	1.74	686	12.56
6	2281	39.02	98	1.68	466	7.97
7	1344	29.84	83	1.84	635	14.1
$\Sigma$	11817	<b>PP 31.18</b>	618	<b>PP 1.63</b>	3063	<b>PP 8.08</b>
	1688.14	31.26	88.29	1.68	437.57	8.18
min	1293	24.22	60	1.03	174	4.02
max	2281	39.02	102	2.09	686	14.1
S <sup>2</sup>	116308.28	24.5	226.8	0.12	37632.12	15.05
Sd	341.04	4.95	15.06	0.34	193.99	3.88
Cv	20.2%	15.83	17.06%	20.24	44.33%	47.43

During the examination of the coefficient of variance, we came to the following results in the entire population on all seven farms: laminitis has a coefficient of variation (CV) of 14.22%, rusterholz's ulcer 20.74%, dermatitis interdigitalis 14.07%, dermatitis digitalis 20.20%, panaritium 17.06%, while fibroma has as much as 44.33%.

## 9. THE APPEARANCE OF HOOV'S DISEASE BY CYCLES AND THEIR INTENSITY

Table 4: Descriptive statistics of diagnosed hoof diseases by farm.

		<b>L</b>	<b>Rh</b>	<b>DiD</b>	<b>DD</b>	<b>P</b>	<b>F</b>
Farm 1		1524.5	329.75	1154	404.5	25	108.25
	Min	1491	229	1053	227	20	76
	Max	1584	489	1279	478	36	140
	S <sup>2</sup>	1871	15815.58	1562	14859.58	55.33	1186.91
	SD	43.26	125.76	39.52	121.90	7.44	34.45
	CV	0.028=2.84%	0.38=38.13%	0.034=3.42%	0.301=30.14%	0.29=29.75%	0.318=31.82%
Σ 6680	Σ	6098	1319	4616	1618	100	433
Farm 2		1323.5	337.25	1013.75	434.75	15	116
	Min	1123	199	872	287	12	97
	Max	1521	484	1248	664	18	132
	S <sup>2</sup>	26232.16	6430.14	26442.91	9118.13	8.66	158
	SD	161.96	80.18	162.61	95.49	2.94	12.57
	CV	0.12=12.2%	0.23=23.77%	0.16=16.04%	0.21=21.96%	0.19=19.62%	0.10=10.83%
Σ 5830	Σ	5294	1349	4055	1739	60	464
Farm 3		1055	285.75	805	403	25.5	51.25
	Min	471	168	622	275	0	0
	Max	1166	358	950	601	77	108
	S <sup>2</sup>	110470.66	4320.20	4846	19612.66	1233.66	600.54
	SD	332.37	65.73	69.61	140.04	35.12	21.51
	CV	0.31=31.50%	0.23=23.00%	0.086=8.65%	0.347=34.75%	1.37=137.74%	0.478=47.81%
Σ 4881	Σ	4220	1143	3220	1612	102	205
Farm 4		1082.25	200	826.25	323.25	20	43.5
	Min	1040	128	695	191	5	10
	Max	1129	241	975	407	61	65
	S <sup>2</sup>	2009.58	2570	13098.91	8087.20	748	484.16
	SD	44.83	350.69	114.45	89.92	27.35	22.00
	CV	0.041=4.14%	0.25=25.35%	0.138=13.85%	0.278=27.82%	1.367=136.74%	0.505=50.58%
Σ 4691	Σ	4329	800	3305	1293	80	174

Farm 5		1228	338	896	482.5	23.75	171.5
	Min	1177	205	775	438	19	125
	Max	1279	479	960	542	30	212
	S <sup>2</sup>	954	15800.66	6927.33	2648.33	23.58	1815
	SD	30.89	125.79	83.23	51.46	4.86	42.60
	CV	0.025=2.51%	0.37=37.19%	0.092=9.29%	0.10=10.67%	0.204=20.45%	0.248=24.86%
Σ 5461	Σ	4912	1352	3584	1930	95	686
Farm 6		1286	353.75	965.5	570.25	24.5	116.5
	Min	1200	221	840	506	17	82
	Max	1399	538	1118	650	37	145
	S <sup>2</sup>	10251.33	23274.91	17076.33	3709.56	85.66	833.66
	SD	101.25	152.56	130.68	60.91	6.26	28.87
	CV	0.079=7.87%	0.43=43.13%	0.135=13.53%	0.106=10.68%	0.37=37.78%	0.24=24.78%
Σ 5846	Σ	5144	1415	3862	2281	98	466
Farm 7		1055	223.5	808.4	336	20.75	158.75
	Min	888	117	699	285	7	112
	Max	1129	330	907	434	54	247
	S <sup>2</sup>	20124.66	9765.66	7317.97	4440.66	497058	3654.25
	SD	141.86	98.82	85.55	66.64	22.31	60.45
	CV	0.13=13.45	0.44=44.22%	0.105=10.58%	0.198=19.83%	1.075=107.50%	0.38=38.07%
Σ 4504	Σ	4220	984	3234	1344	83	635

The coefficient of variation is used to compare the variability of different samples. Analyzing the obtained coefficients of variation in the occurrence of hoof disease on the observed farms, we came to the following results: farm F1 has the highest CV for rusterholz's ulcer, 38.13%, and the smallest variation for laminitis, 2.84%, on F2, Rh also has the largest variable with 23.77% and the smallest fibro with 10.83%, Panaricum on farm 3 had by far the largest variation with a coefficient of 137.74%, while dermatitis interdigitalis is represented by 8.65%, on the farm F4 panaritium also has a high degree of variability, 136.74%, while on this farm laminitis has the lowest variability with 4.14%. Farm F5 has the highest CV of rusterholz ulcer at 37.19%, while laminitis is at 2.51%. F6 is under the same influence of high Rh variability, 43.13% and stable laminitis, 7.87%. On the farm, F7 panaritium has the highest rate of variability of 107.50%, dermatitis interdigitalis has 10.58% as the smallest variable on this farm.

## 10. DISEASE PREVALENCE BY FARM

The results shown in Table 1 refer to the prevalence of certain diseases within one farm, so that on the F1 farm, during 4 cycles of hoof processing within laminitis, we have a

constant reduction of newly diagnosed cows, which indicates that the management of this farm has taken the problem seriously and is continuously trying to improve the status and nutritional regime of its cows. With Rusterholz's ulcer, the situation is completely different; its temporary improvement drastically worsens at the end of the fourth cycle to as much as 98.48% compared to the previous cycle. Dermatitis interdigitalis, from the initial decrease, moved again in a positive direction, but not to such a large extent, which indicates the problem of diagnosing this disease. Dermatitis digitalis is constantly decreasing, which is an indicator of increased concern about the hygiene of the throat accommodation facility. Panaritium is also in constant decline because hygiene has definitely improved on this farm during the two years of paddock processing. Fibroma has variations of increase and decrease, but a constant number of patients, without major fluctuations.

On the F2 farm, the situation is as follows: laminitis is slightly increasing during all four cycles, which can be an indicator of poor quality components in the diet, Rh is constantly increasing during all four cycles of processing, which indicates that nothing has been done in terms of architecture and that the trend of increasing the number of patients will continue to be followed over time, DiD is constantly in the interval of 60.26% - 76.27%, which is not great but there are no major deviations; DD with its 16.63% during the first cycle and 45.88% at the end of the fourth cycle indicates a big problem of hygiene and implementation of animal hygiene measures; panaritium is within the average limits and does not deviate much from the average; The appearance of fibroids is also continuous without major deviations during all four cycles, ranging from 5.62% to 9.12%.

From the initial 69.18% laminitis with minor variations, the F3 farm finished the fourth round with 93.57%, which represents a serious problem in two years. By changing the feeding technology, as well as by using an inadequate amount of concentrated nutrients, an increase in milk can be obtained, but at the expense of the animal for a longer period. During the first two cycles, Rh was somewhat reduced, but in the third and fourth cycles, it progressively increased to as much as 28.73% of the total yield on the farm. During the second and fourth cycle, DiD was on the increase in the number of patients, which indicates that bacterial diseases spread more easily during the warm summer months. DD is constantly represented with a slight tendency to decrease from the first to the fourth cycle, which indicates attempts to maintain hygienic conditions. Panaritium was diagnosed to the greatest extent during the third cycle, as much as 6.43%, which indicates a serious problem within the gap, as well as the possible occurrence of a mini-epidemic. Fibroma varies from 1.16% to 8.66%.

Farm F4 continuously had a prevalence of laminitis from 88.68% to 91.46%, Rh varied from 10.48% to 20.14%, DiD went from the initial 54.59% with a smaller variation

to 70.36%, while the number of diagnosed heads with DD doubled from 15% to 30.78%, which indicates serious neglect of hygiene, Panaricium except for the jump during the third cycle of 5.27% was below 1%, fibroma did not vary significantly except during the third cycle when it was in decline by 0.86%, only to jump to 4.83% in the next cycle. This phenomenon is not common and indicates a wrong diagnosis, i.e. incompetence of the team for processing the clows or ignorance in recognising the specific disease.

Farm F5 increased the number of head affected by laminitis from 79.29% at the end of the first cycle to 96.5% at the end of the fourth cycle. Rh increased from the initial 13.38% to 37.21%, which may also indicate inexpertly processed hooves during the previous two cycles. The increase in the presence of Rh, in addition to unprofessional treatment of hoofs, also affects the increase in the number of people suffering from DiD when the damaged part of the heel horn is removed and by not placing the blocks, the attitude of the animal deteriorates, poor placement or non-placement of the blocks, therefore, creates the possibility for the occurrence of Rh, as well as the throats that have suffered from chronic laminitis are more susceptible to the secondary disease rusterholz's ulcer. DiD is constantly increasing, which confirms the theory of an increased number of Rh. DiD increased from 66.70% to 70.70% from the first cycle. DD continuously appears in the range from 33.34% to 40.99%. Panaritium ranges from 1.25% to 1.95%, which is the average of the entire population of all seven farms. Fibroma varied from 9.09% to 15.77%.

On the F6 farm, laminitis increased from 78.28% at the beginning of the first cycle to reach a value of 95.65% at the end of the fourth cycle. Rh, from the initial 13.36%, reached a record 38.29% of the total number of heads, which again confirms that the number of DiD increased over two years from 62.56% to 73.23%. DD ranges from 36.37% to 43.82%, which indicates fairly uniform carelessness towards hygiene. Panaritium increased from 0.95% to 2.63% and indicates the general negligence of health care and prevention, as well as timely treatment of sore throats. Fibroma occurs in a range of 7.88% to 12.95%.

On the F7 farm, during the third cycle, laminitis reached a maximum of 100% of the population on the farm, only to later drop to 92.84% with the introduction of younger heads into production, which is an excellent indicator of inadequate nutrition of the exploited heads. Rh varied from 11.90% during the first cycle to 27.30% in the fourth cycle. DiD was constantly decreasing during all four cycles, from 81.79% to 67.76%. DD oscillated from the highest 35.9% in the third cycle to 25.49% in the last cycle. Panaritium reached its peak during the second cycle at 4.92% before returning to the general average of 1.06%. The fibroma ranged from min. 10.76% up to max. 20.31% during the fourth round.

## 11. ANALYSIS OF THE OCCURRENCE OF HOOF'S DISEASE BY PROCESSING CYCLES

Table 2 shows the prevalence of diagnosed diseases within the entire population of cattle on all seven AC Corporation farms. She indicates that 90.29% of the population suffered from laminitis, which means that on most farms, the concept of nutrition is not at a satisfactory level, that little attention is paid to preparing adequate meals for high-milk cows, and that this is repeated year after year.

In the examined herds, 21.82% of the population has been diagnosed with Rusterholz's ulcer, which indicates inadequate architecture, that is, the problem lies in the fact that the buildings were built in the 60s of the last century. For the throat format that was current at the time. During long-term selection, in addition to increasing the amount of milk, the format of the throat also increased, so that the beds became too short. Also, one of the factors in the increase in the number of cows affected by Rh are cows in which adequate DiD therapy was not carried out or correction of the heel part of the hooves was carried out inexpertly and thus disturbed the posture and support of the cow, resulting in stretching of the deep flexor tendon, which is a prerequisite for the occurrence of Rh. Chronic forms of laminitis, as a result of which the cornea is weakened, brittle and brittle, and it easily breaks and leads to the creation of space for the appearance of secondary diseases such as Rusterholz's ulcer or various forms of dermatitis. The share of 68.28% has dermatitis interdigitalis, which indicates a big problem of hygienic conditions inside the facility, but also that the disease is more difficult to notice and that there is no systematic approach to its elimination. Dermatitis digitalis is represented by 31.18%. Also, the cause is poor hygiene inside the facility, with the fact that the faster it manifests a clinical picture that can be disturbing, and the immediate perpetrators report it more often as a problem, therefore it is solved faster and easier than dermatitis interdigitalis.

Panaritium was found in 1.63%, and it is at the last level in terms of frequency of occurrence, but when we take into account that in most cases it is not curable and that those throats are excreted from further production, we conclude that it is an economically very important disease on the farm. Fibroma, with the participation of 8.08% of the population, represents one of the moderately severe diseases because the causative agent is still unknown, and improvement sometimes occurs spontaneously.

## 12. COEFFICIENT OF VARIATION OF HOOF DISEASE BY FARMS

Table 3 gives us a comparison of diseases by farm, as well as an insight into their frequency and the percentage of diseased individuals per farm and in the entire region

on all seven farms. During all four cycles, the number of diagnosed necks with laminitis is at F1 91.29%, F2 90.81%, F3 86.46%, F4 92.28%, F5 89.95%, F6 87.99% and at F7 93.69%, which leads to a figure of 90.29% of the total population treated. The coefficient of variation had a relatively low level of 14.22%, which indicates that there is no significant shift in the way of feeding and the selection of components for nutrients in relation to the first and fourth cycles. Under the diagnosis rusterholz ulcer (Rh) is on F1 19.74%, F2 23.14%, F4 18.48%, F5 24.76%, F6 24.2% and F 7 19.85%.

The total coefficient of variation of all seven farms is 20.74%, which leads to the conclusion that the variation is moderately high, but looking at the farms, the percentage of patients is in a small range from 18.48% to 24.76%, quite homogeneous, with an average of 21.82%. We must take into account the architectural deficiencies of the facilities where the hoofs are permanently housed, as well as the number of hoofs diagnosed with DiD and laminitis, in which a different position and angle of the hoofs is made during therapy. If this is not corrected with auxiliary means, the emergence of Rh is inevitable. The number of heads suffering from dermatitis interdigitalis (DiD) is on average 68.28% of the total population, and that is on F1 69.1%, F2 69.55%, F3 65.97%, F4 76.35%, F5 65.63%, F6 66.06% and on F7 71.8%, except for farm F4, which has 10% more sufferers. from other mostly uniform farms.

The coefficient of variation for the total population is 14%, which is not such a large deviation and fluctuation within the observed group. Dermatitis digitalis is a typical bacterial disease caused by poor hygiene practices and animal carelessness. It is favoured by high temperatures during the warm months, as the animals wet themselves more with water to cool down. If we add to that irregular fertilising, an ideal basis for the development and spread of bacteria causing DD is created. This is supported by our indicator of 20.2% coefficient of variation within the entire population. Of that, F1 24.22%, F2 29.83%, F3 33.03%, F4 27.56%, F5 35.34%, F6 39.02%, and F7 29.84%. Panaritium on the observed farms appeared in the following percentages: F1 1.5%, F2 1.03%, F3 2.09%, F4 1.85%, F5 1.74%, F6 1.68%, and F7 1.84%, which represents a fairly uniform coefficient of variation of 17.06%. Thanks to F3, which has as many as 2.09% of patients with this hard-to-treat disease. Panaritium is a purulent inflammatory disease of the coronal edge of the hooves caused in most cases by mechanical damage to the coronal edge of the hooves or prolonged and untreated mastitis, pyometra, endometritis, or inflammation of the joints. In the early stages, therapy is applied parenterally in the form of broad-spectrum antibiotics and treatment of the primary causative agent, when it leads to the desired results, i.e. to the complete recovery of the animal. The problem is that such animals are

not identified in time, and when there is a clear clinical picture (swelling of the crown edge, moderate and painful swelling of the tarsal or metatarsal joint), the treatment is in most cases unsuccessful or requires significant financial costs (in the form of the consumption of a large amount of drugs, a withdrawal period for milk and meat), so that the treatment is generally abandoned and the animal is sent to forced slaughter, i.e. it is excreted from further production. Through this research, we have come to the conclusion that fibroma is one of the most heterogeneous diseases in this population, with a coefficient of variation of as much as 44.33%. Given that its origin is still not completely clear to the scientific public, these results support that. Several factors have been identified as possible causes of fibroids or interpalpatal hyperplasia, namely: genetic predisposition, viral and bacterial agents, poor leg posture, untreated fractures/dislocations of the phalanges, excessive body weight, diseases of the joints of the extremities, but none of these factors is decisive or the primary cause of the occurrence of this disease. Fibroma therapy is carried out as follows: if the hyperplasia is small and aseptic, it is possible to act on it locally in the form of salves or different types of medication in the form of a spray, until it dries up and then falls off spontaneously; but if the hyperplasia is larger, surgical intervention is necessary, when the hyperplastic tissue is removed with a wedge incision under local anesthesia, in the interpalpatal space, if necessary, the wound can be treated with thermocautery, without suturing. Neither method is a guarantee that a relapse will not occur after some time. During this research, not a single surgical intervention was performed on the affected throats, which leads to the conclusion that spontaneous self-healing occurs in some cases of this disease, which supports the finding of great variation within the population.

### 13. COEFFICIENT OF VARIATION OF HOOF DISEASE BY FARMS AND PROCESSING CYCLES

Table 4 presents the coefficient of variation of a particular disease within each farm during four hoof beard cycles or over two years. By analysing the data, we came to the conclusion that on F1, the greatest degree of variation was Rh disease with 38.13%, followed by F with 31.82%, and the least degree of variation was laminitis with 2.84%. On farm F2, Rh had the highest variability with 23.77%, and fibre had the lowest with 10.83%. The F3 farm had significantly greater fluctuations, namely, panaritium varied significantly and even 137.74%, followed by Fibroma with 47.81%, DD with 34.75%, laminitis with 31.5%, RH with 23.00% and with the least oscillations DiD with 8.65%. Farm F4 also had the highest variation in panaricium 136.74%, followed by fibroma with 50.58%, DD with 27.82%, Rh with 25.35%, DiD with 13.85%, and laminitis with 4.14%.

Almost the same situation with panaricium and fibroma as on the F3 farm indicates periodic occurrences of both diseases, and a problem in their treatment. If we take into account that the largest number of diagnosed panaritiiums on both farms occurred during the cold month of December, then this result points us to the problem that when the minuses are big, the fertilizing equipment can freeze and be unusable for a certain period of time, which ultimately leads to the accumulation of manure and the uncontrolled development of pathogenic bacteria and the expansion of bacterial diseases. Farm F5 had the biggest variation with Rh of 37.19%, then with fibroma of 24.86%, and Panaricium 20.45%. While other diseases can be said to have varied to a lesser degree, from 2.51% for L, 9.29% for DiD, and 10.67% for DD. Farm F6 had greater deviations with Rh, namely 43.13%, P with 37.78%, F with 24.78%, while laminitis with 7.87%, DiD with 13.53% and DD with 10.68% were more constant. On the F7 farm, Panaricium showed the greatest deviations at 107.50%, followed by Rh at 44.22%, F at 38.07%, DD at 19.83%, L at 13.43% and DiD at 10.58%.

Looking at all this collected data, we can notice that the biggest variations were among the appearance of Rusterholz's ulcer, panaritium and fibroma, while laminitis, dermatitis interdigitalis and dermatitis digitalis were in a smaller variation, i.e. there was no major improvement or deterioration after four cycles.

In support of all these data, the fact that the number of cattle removed from production on AC Corporation's farms is not small is described in their scientific work. The tables they attached are an excellent indicator of the problem with diseases of the hoofs in the whole region; the percentage of throats discharged due to diseases of the hoofs is 22.66%.

Table 5: The share of culled cows according to the reason for culling within the groups, according to the share of genes of the Holstein Friesian breed.

Causes of culling	HF groups				
	I	II	III	IV	V
	%	%	%	%	%
RD	40,93	31,79	27,39	23,71	16,73
MD	11,40	10,68	10,10	8,54	6,30
MS	8,81	8,13	11,33	15,55	19,41
FHD	7,77	9,54	12,58	17,15	21,66
SE	7,77	10,52	8,36	5,56	2,68
Other	7,51	9,02	10,33	10,78	11,61
IPD	5,96	8,89	5,04	1,68	0,75
DCA	4,66	6,96	8,43	8,35	9,30

DD	3,11	3,20	4,81	6,60	8,93
IN	2,07	1,27	1,65	2,09	2,62
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

Legend:

RD - reproductive problems and infertility

MD – metabolic diseases

MS - mastitis

FHD - foot and hoof diseases

SE – selection characteristics

IPD – infectious and parasitic diseases

DCA – difficult partus and abortion

DD – digestive disorder

IN – injure

Table 6: The share of culled cows according to the reason for culling within the relative production of the cow in the first lactation.

Causes of culling*	Production level in the first lactation								
	<-1,5 SD	-1,5 SD<x<-1 SD	-1 SD<x<-0,5 SD	-0,5 SD<x<-0,2 SD	-0,2 SD<x<0,2 SD	0,2 SD<x<0,5 SD	0,5 SD<x<1 SD	1 SD<x<1,5 SD	x > 1,5 SD
	%	%	%	%	%	%	%	%	%
RD	33,67	30,10	29,84	28,67	27,72	23,74	25,55	19,91	16,50
MS	12,83	12,43	10,20	11,83	12,05	12,47	12,78	16,70	14,67
SE	12,67	12,04	9,96	7,80	6,64	6,87	4,54	3,43	3,06
FHD	7,67	8,44	9,63	13,13	13,99	16,31	16,86	19,91	22,86
Other	7,50	8,29	9,82	9,69	9,55	10,95	11,28	11,67	13,45
MD	7,33	8,29	10,06	9,56	9,34	10,15	10,31	8,14	9,9
IPD	7,00	7,66	8,17	5,27	4,54	3,52	1,75	1,07	0,61
DCA	6,00	6,88	7,13	7,15	9,19	8,79	8,82	9,85	7,82
DD	3,33	4,14	4,06	4,62	5,26	5,12	7,13	6,21	8,80
IN	2,00	1,72	1,13	2,28	1,74	2,08	0,97	3,1	2,32

Legend:

RD - reproductive problems and infertility

MS - mastitis

SE – selection characteristics

FHD - foot and hoof diseases

MD – metabolic diseases

IPD – infectious and parasitic diseases

DCA – difficult partus and abortion

DD – digestive disorder

IN – injure

With the increase in production in the first lactation, the share of cows culled due to hoof and leg diseases also increased, so that in the most productive group in the first lactation of the total number of cows, as many as 22.86% were culled due to hoof and leg diseases.

## 14. CONCLUSION

The sentence “a complete understanding of the problem leads to its correct solution” absolutely finds its application in the treatment of the problem of bovine hoof disease. A partial approach to this problem inevitably leads to a decrease in production in the pasture, an increase in the cost of remediating health problems, and a progressive deterioration of the health status of every improperly treated or untreated animal.

For the above reasons, the first step in suppressing all diseases of cattle feet is to constantly raise the level of biotechnical thinking of all employees in cattle production, with the incorporation and application of educational programs on the importance of preventive measures and procedures. By analysing the collected data, we conclude that certain diseases, such as laminitis with a coefficient of variation CV 14.22%, dermatitis digitalis with a coefficient of variation CV 20.2% or dermatitis interdigitalis with a coefficient of variation CV 14.00%, regardless of the effort and commitment of the workers on hoof processing, cannot be significantly reduced. It is necessary to raise the level of the biotechnological way of thinking of the management and systematically stand in the way of failures, invest in new technologies and prevention, in order to reduce the occurrence of the mentioned diseases on farms.

In order to reduce the number of cows suffering from laminitis, the nutrition of cattle must be constantly monitored according to categories and individual needs, and the feed must be controlled for the presence of bacteria, viruses and fungi (mycotoxins). In the systematic suppression of the occurrence of laminitis as well as its therapy, it is necessary to achieve a consensus of all agricultural experts in the technological chain of making animal feed with a special emphasis on the nutritional profile, to properly balance the meal while respecting the basic and production needs for nutrients, minerals and vitamins, of each individual animal. The first symptoms should be responded to quickly, and further complications of this disease should be prevented.

When it comes to dermatitis interdigitalis and dermatitis digitalis, the greatest attention must be paid to increasing the hygienic conditions inside the facility where the animals stay. These two diseases are the result of bacterial insults. It is necessary to suppress their action, reproduction and spread in the form of prevention. The primary

preventive measures refer to the fact that the substrate must be dry and clean, and that regular disinfection and disinsection measures are carried out. If a mat is used, as is the case on these farms, regular fertilising must be done at least twice a day; keeping the fertilising machinery in working order goes without saying. Secondary preventive measures would refer to the construction and regular use of de-barriers within each farm in order to prevent and reduce bacterial diseases, and the implementation of animal hygiene measures aimed at preventing the introduction of infectious agents by persons in charge of production, supply, maintenance and treatment on the farm, as well as visitors in direct contact with animals and their habitat. Reducing the negative consequences of digitalis dermatitis and interdigitalis dermatitis in cattle needs to be done systematically, uncompromisingly and persistently, while shifting the focus from curative to preventive.

When it comes to other diseases that are not so frequent on any of the seven observed farms, rusterholz ulcer PP 21.82% with a coefficient of variation CV 20.74%, panaritium PP 1.63% with a coefficient of variation CV 17.06% and fibroma PP 8.08% with a coefficient of variation CV 44.33% and if they have a high coefficient of variation, they do not seriously threaten production. Rusterholz's ulcer leads to a significant decrease in the production characteristics of the affected throat; the decrease in milk yield can be as much as 35%, which represents significant losses in the owner's profit.

Adequate, regular, professional and timely hoof processing can prevent consequences that not only bring losses in production, but also increase its costs. When treating Rusterholz's ulcer, the therapy must be carried out by a professional, experienced and trained person, so that the therapy lasts as short as possible and its effects are visible as soon as possible through production results. It is necessary to introduce an accurate recording of the distribution of fibroids in conditions of intensive cattle keeping, due to the negative impact of this disease on production characteristics. If possible, it is necessary to carry out a stricter selection and elimination from breeding of receptive heads. When diagnosing a severe and extremely severe form of fibroma, the animal should be used economically.

Panaritium, although the least common in the entire population PP 1.63%, is a very serious problem in cattle production, because the treatment of this disease requires significant costs, temporarily excludes the animal from production due to parenteral antibiotic therapy, and often, the therapy does not have the desired effects. Due to all these factors, in most cases, the animal is removed from further production before any therapy and sent to forced slaughter. The primary causes of panaricium are bacteria present in the animal's habitat and mechanical injuries to the extremities. Panaritium also occurs as a

secondary disease in retention, mastitis, pyometra, endometritis, and joint diseases. There is no prevention of paratuberculosis, but its early forms can be successfully treated.

The data on the percentage of cows removed from further production are more than devastating, if we take into account that the average market value of each cow is around €1,300, (we do not count the costs of breeding and registering such a cow), and 22% of 9,000 cows on an annual level is 1,980 cows at €2,000, we come to a loss of basic assets in the amount of €3,960,000 per year, just from diseases of the claws. Bearing in mind all the circumstances that bear diseases of the claws, from the reduction of production characteristics, the pain that animals suffer, economic losses (excretion), it is necessary to implement the best possible preventive measures, so that the curative is as small as possible.

Looking at the obtained results, we come to the conclusion that hoof diseases of HF breed cows in an intensive way of keeping can be brought under control, and some can be reduced by correcting technological measures and procedures, especially during hoof processing.

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## SOBRE O ORGANIZADOR

**EDUARDO EUGÊNIO SPERS** realizou pós-doutorado na Wageningen University (WUR), Holanda, e especialização no IGIA, França. Possui doutorado em Administração pela Universidade de São Paulo (USP). Foi Professor do Programa de Mestrado e Doutorado em Administração e do Mestrado Profissional em Comportamento do Consumidor da ESPM. Líder do tema Teoria, Epistemologia e Métodos de Pesquisa em Marketing na Associação Nacional de Pós-Graduação e Pesquisa em Administração (ANPAD). Participou de diversos projetos de consultoria e pesquisa coordenados pelo PENSA e Markestrat. É Professor Titular no Departamento de Economia, Administração e Sociologia, docente do Mestrado em Administração e Coordenador do Grupo de Extensão MarkEsalq no campus da USP/Esalq. Proferiu palestras em diversos eventos acadêmicos e profissionais, com diversos artigos publicados em periódicos nacionais e internacionais, livros e capítulos de livros sobre agronegócios, com foco no marketing e no comportamento do produtor rural e do consumidor de alimentos.

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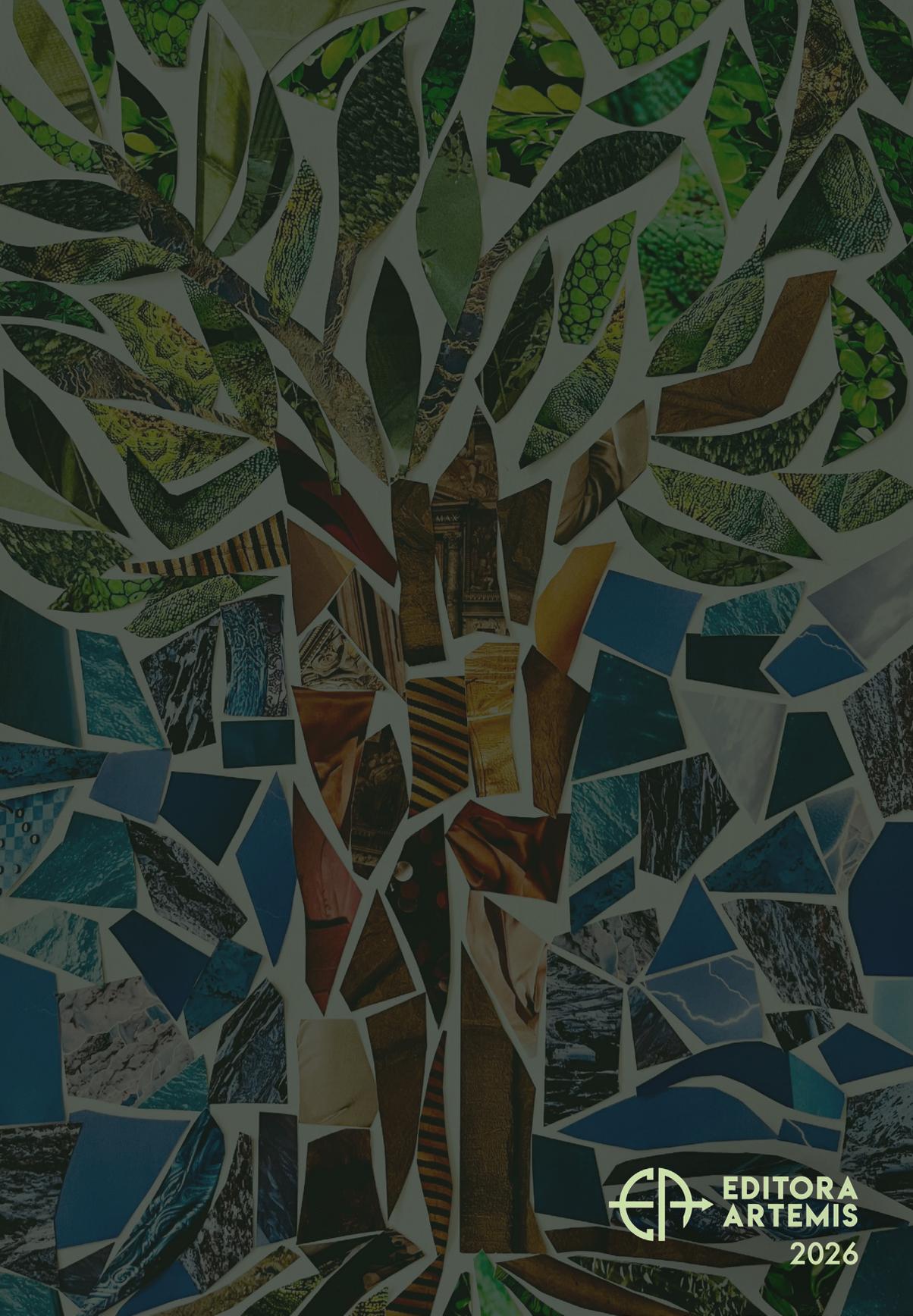
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