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OVERVIEW OF MECHANIZED CARE EQUIPMENT BY THE HOOVES OF CATTLE**Anatolii HRYTSUN**, Candidate of Agricultural Sciences, Associate Professor**Olena SOLONA**, Candidate of Technical Sciences, Associate Professor

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The current conditions of keeping cattle in specialized industrial complexes and large farms often lead to traumatism of the hooves, which can ultimately lead to pathology of the limbs. This negatively affects the productivity of animals and, as a result, causes significant economic losses in the livestock sector.

Several reasons have been identified that cause trauma to cattle limbs and lead to their pathology. Yes, hard surfaces, slotted floors, and conveyor-type conveyors for removing manure have a negative effect on the animals' hooves. Up to 40% of animals suffer from limb diseases when cows are tethered, while up to 90% in monoblock cowsheds of the untethered type. In dairy enterprises, among all mechanical injuries to cows, from 60% to 80% are limb diseases caused by trauma to the hooves and toes.

In order to prevent and successfully treat horn diseases in cattle on specialized farms and dairy complexes, it is necessary to improve treatment methods, animal care rules, and methods of cleaning and trimming horn growth of hooves.

Trimming and cleaning of hooves are quite time-consuming operations, which are among the mandatory measures for the prevention of diseases of the limbs of animals. This operation is performed 2-3 times a year. At the same time, the excess layer of horny growth is cut off, and the legs are given an optimal shape. This ensures uniform distribution of the load over the entire support surface of the limb.

The used mechanical means for trimming hooves have some disadvantages. Such a large mass and the lack of regulation of cutting modes depending on the physical and mechanical properties of the horn growth do not contribute to high-quality processing of hooves.

The review of systems and equipment for cutting hoof horn growth in cattle, especially cows, shows that this direction of research is relevant and promising.

To increase the productivity of trimming hooves and ensure their natural geometric shape and the necessary roughness of the treated surface, it is advisable to conduct further research on the justification of structural and technological parameters and modes of operation of mechanical equipment for effective care of cattle hooves.

Key words: *cattle hooves, hooves care, roughness of hooves of hooves, mechanisms for trimming hooves.*

Fig. 8. Table. 3. Ref. 8.

1. Formulation of the problem

The conditions of keeping animals in some large specialized farms and industrial complexes often lead to injuries of their limbs, a serious complication. Several reasons have been established that lead to injuries and the development of pathology of the limbs of cows. These can be slotted floors and hard surfaces, conveyors for removing manure, devices for fixing cows. Limb diseases are registered in 40% of cows in tethered housing conditions, and in 90% in monoblock type cowsheds. In dairy complexes, among all mechanical injuries in cows, from 60% to 80% are diseases of limbs, mainly fingers and hooves.

In order to prevent and successfully treat hoof diseases in cows on specialized farms and dairy complexes, it is necessary to improve treatment methods, animal care rules, methods and equipment for cleaning and trimming hooves.

When clearing compressed (crooked) hooves of cattle, it must be taken into account, if they are not amenable to treatment, that by adjusting the correct trimming of the horn growth and, as a result, correction of the hooves, it is possible to slow down the progression of pathological changes. Taking into account the role of the walls when the animal rests on the surface, their edges are not really cut, but only that part of the horn growth that wraps around the sole is cut. The sole edges of the hoof walls should be in the same plane.

2. Analysis of recent research and publications

The hooves of the hoofs in cattle act as shock absorbers. At the expense of separate anatomical formations, they dampen the shocks and blows experienced by the limbs at the moment of support.

The horn wall of the hoof 1 of the hoof performs the main protective and supporting functions. All tissues located in the inner layers are protected by it from mechanical damage and other physical effects (Fig. 1).

The hoof horn sole 5 together with the horn wall performs a supporting function, but to some extent provides mitigation of shocks and shocks that occur when the animal moves. Corneal sole protects internal tissues from mechanical, physical and chemical effects [1].

The bulk of the horn growth of the hoof wall in a healthy hoof grows from top to bottom, namely from the crown edge to the sole.

The elongation of the corn due to its growth in a normal rats 5-7.5 mm per month. Its faster growth occurs in the heel part of the legs and on the outer horn wall. The growth of the horny outgrowth of the sole occurs independently of the growth of the hoof wall and is directed from top to bottom [7].

The thickness of the horn wall is different in different parts of the hoof. It is the thickest in the hooked part and gradually decreases in the middle of the rod. Horn growth in the area of the intercalary wall is thin and does not exceed 5 mm. The outer layer is thicker and reaches up to 7 mm. The corneous sole consists of a tubular corneous process 2.5...3.5 mm thick [1, 2].

Physiologically, the normal function of the hooves is correct and their hooves can be shaped only when the weight of the animal's body is evenly distributed over them. This is possible with a uniform ratio of the rate of growth of new and abrasion of the old horny growth. When these conditions are violated, the hooves of the ungulates take the wrong physiological form.

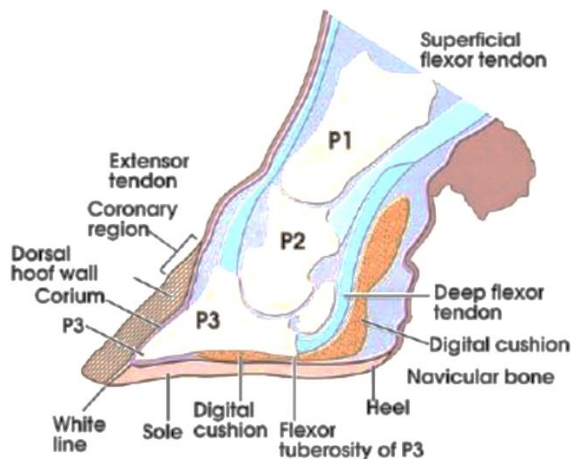


Fig. 1. Anatomical structure of the cattle trunk

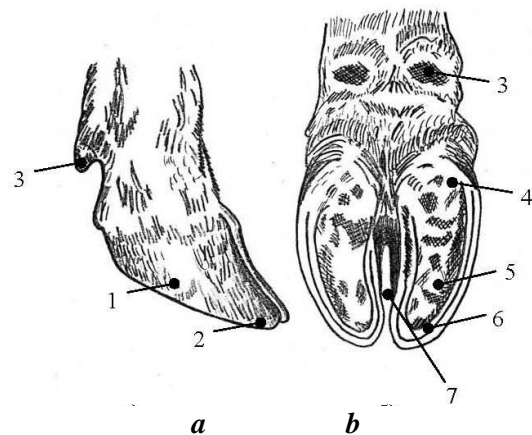


Fig. 2. Cattle rump: a) side view; 1 – horn side wall of the hoof; 2 – baking wall; 3 – rudimentary hooves; b) view from the sole; 4 – soft dough; 5 – horny sole; 6 – white line; 7 – inter-hoof space.

Deformation of the scrotum with its untimely elimination often leads to various complications, the main of which are pod dermatitis [3].

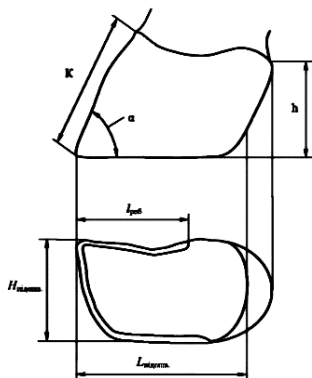
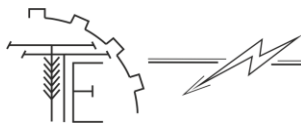


Fig. 3. The main geometric parameters of the hoof of cattle

In a healthy rat's hoof, the horn wall has the correct geometric shape, and its surface is shiny, smooth and without cracks. The elongated edge of the horn wall has solid and fracture-free edges. On the sole surface, the white line should not be distorted and visible, in the form of a narrow strip. The sole surface of both healthy hooves should be the same in shape and size. The horn growth of the hooves should be elastic and tear-resistant [1, 2].

According to studies, the lack of care for cow hooves significantly reduces annual lactation, while timely cleaning helps increase milk yield per cow [3]. They say "milk on the cow's hooves".



3. Presentation of the main material

There are many causes of hoof disease. These are inferior and unbalanced feeding, hypodynamia, high crowding of animals, injuries, low quality and imperfection of the floor construction, non-fulfillment of zoohygienic and veterinary requirements for keeping animals, lack of planned and systematic care of the cages, etc. [4].

During clinical and orthopedic studies, the positioning of the limbs and the placement of the axis of the finger bones are taken into account. The degree of regrowth or abrasion of the plantar surface of the hooves and the zone of the most intense abrasion are determined. Pathological changes in the area of the crown, wall, sole, pulp, skin of the interhoof gap, as well as other painful processes in the area of the hindquarters are revealed.

A list of the main measures that must be carried out for the prevention of diseases of the cattle's ruts, with any type of keeping, is given in table 1.

Table 1.

List of measures for the prevention of cattle diseases

Name of the event	Purpose of the event	Frequency of conducting	Venue	Means for carrying out
Circumcision hoove	Cutting the excess horn	2-4 times a year	Field, cowshed	Fixing machine
Clearance hooves	Cutting of excess horn	2-4 times a year	Playground, cowshed	_____
Hoof baths	Disinfection, hoof horn strengthening	4 times a year	Milking hall, Playground	Containers with disinfectant solution
Active exercise	Improves metabolism, wears out the horn	Everyday	Exercise playground, indoor track	Tracks with hard and soft surfaces

It is known that the biophysical and biochemical properties are not the same on the entire support plane of the rat [2].

Table 2.

Biophysical and biochemical parameters of the hoof horn of cows

Indicators	Average density of the sole	Rear part of the sole	Sole part of the pulp	Rear part of the hoof	Inner wall of the hoof
Density, kg/m ³	1,211	1,198	1,183	1,422	1,313
Hardness, mind. unit	86,8	72,7	69,7	98,9	82,7
Stretch (tear),%	70,0	75,3	87,2	57,3	61,1
Abrasion resistance, rev/min	107	89,2	80,0	120±0,6	110,1
Thermal conductivity	1536,0	1629,0	1945,0	1427,0	1489,0
Keratin denaturation, °C	620,5	598,2	37,2	680,8	670,1
Moisture, %	33,3	34,6	0,92	26,4	28,8
Ash, %	1,0	0,95	0,08	1,7	1,4
Fat, %	0,07	0,07	0,08	0,06	0,07
Protein, %	91,8	91,6	91,1	92,2	91,9

The strongest horn is the middle part of the sole of the hoof, compared to the rear third of the sole and the plantar surface of the soft tissue, and the outer side wall of the shoe horn compared to the inner and sole horn. Existing methods of processing hooves and mechanical means for their implementation.

The following tools are used to clean the hooves of cattle: hoof nippers, rasps, hoof knives, special scissors with long handles (Fig. 4) [1, 4].



Fig. 4. Hand tools for cleaning hooves

To carry out operations on clearing the hindquarters and trimming the hoof horn, the animal is fixed in a special machine [8].



Fig. 5. Machine for caring for animal hooves

Among the most well-known tools for trimming hooves, keratographs are most often used. The design of one of them, the KF-1 keratograph, is shown below (Fig. 6) [5].

Cylindrical cutters 1 have inclined cutting elements of the right and left direction. The design of the keratofreza allows you to treat the outer and inner walls of the hoof at the same time.

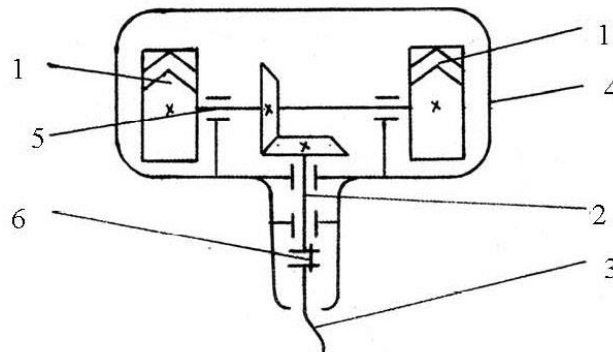


Fig. 6. Scheme of KF-1 keratoplasty: 1 – cylindrical cutter; 2 – drive shaft; 3 – flexible shaft; 4 – corpus; 5 – driven shaft; 6 – coupling



For treatment of cattle's necks with keratofreeze, the animal is placed in a special machine, and the treated limb is fixed in a certain position. The operator, holding the keratograph in his hand, cuts off the excess horn growth of the hoof wall with its cutting elements. Control over the quality of trimming and the amount of cut horn is carried out visually. The technical characteristics of this milling cutter are given in table 1.2.

A stationary type device is also used for cleaning cattle pens, the diagram of which is shown in Fig. 7. [5].

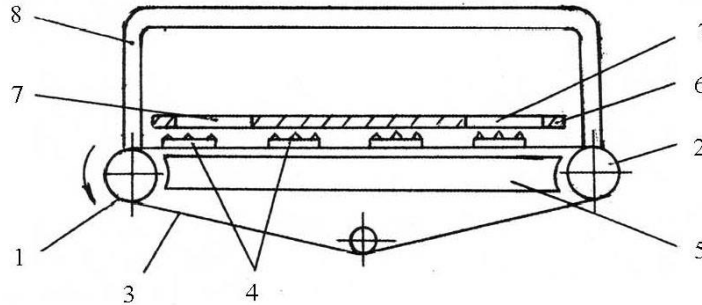


Fig. 7. Hoof cleaning device: 1 – leading drum, 2 – driven drum, 3 – tape, 4 – cutting elements, 5 – support surface, 6 – limiting surface, 7 – holes, 8 – fence

The limbs of the animal, which are to be processed by the slats, are lowered (directed) into the holes 7 of the limiting surface 6. The animal and its limbs are fixed. They include a drive that drives the tape 3 with cutting elements 4. The sole part of the animal's hooves rests on the tape and cutting elements fixed on it. Movable cutting elements 4 have notches on the outer surface, thanks to which the layer of horny growth is removed. The technical characteristics of such equipment are given in table 3.

Table 3.

Technical characteristics of mechanical means for trimming hooves

Type of device	Working bodies	Type of device Working bodies Power of the electric motor, kW	Rotational frequency of the electric motor shaft, rev/min	Speed of movement of working bodies, m/s	Roughness of the machined surface, Ra	Productivity, heads/hour
Manual	Cylindrical cutters, chevron	1,1	920	4,5	6,3...8,0	3...5
Stationary	Rasp plates	4,0	716	0,15	12,5...16,0	12...20

The most common method of cutting cattle hooves is keratofresis.

However, it has a number of disadvantages. The massive working part (weight of the head 2...3 kg) and the inability to process the sole and heel part of the hoof do not ensure high-quality work. After all, a heavy head with cutting elements leads to rapid fatigue of the operator, and the design of the cutting elements does not provide the necessary depth of cutting of the horn growth of the rat. The treated surface acquires a wavy shape, which requires fine manual processing with a knife.

The stationary device for cleaning cow udders has cutting elements in the form of rasp plates. It also lacks a mechanism for adjusting the cutting depth. The design of this device is designed to clean properly formed hooves. When processing hooves with deviations from the normal shape with the device, the possibility of damaging the heel part of the sole with rasp plates is not excluded. The hoof horn cutting process on this device is difficult to control.

Taking into account the shortcomings of existing devices Rybalko V.M. [5] a device with knife-like cutting elements for the care of cattle. In his research, he used the theory of wood cutting to determine the main parameters and conditions for the process of cutting the horn growth of cow hooves.

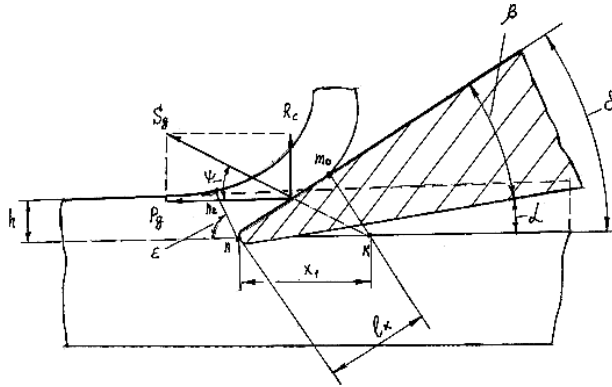


Fig. 8. Geometric factors affecting the process of cutting material with a knife element

The design allows you to adjust the cutting speed, use different cutting elements, in accordance with the physical and mechanical properties of the hoof horn.

4. Conclusions

However, significant issues of cattle herd care are understudied or have not been studied at all. In our opinion, the mechanical properties of the horny outgrowth of the hooves of cattle have not been studied enough. Thus, the design of mechanized means for cutting horn growth and clearing the rump of animals needs a deeper study. The existing technique involves the processing of areas of hooves without taking into account the characteristics of the animal, i.e. the "correct" shape.

It is advisable to carry out these operations using robotic systems that will take into account the peculiarities of the individual physiological characteristics of animals. They require a more detailed study of the mode of operation of the knife elements for cutting the horn growth, depending on its physical and mechanical properties.

The listed questions require theoretical and experimental research, which creates prerequisites for the development of improved mechanical means for caring for cattle herds, especially dairy cows.

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ОГЛЯД МЕХАНІЗОВАНОГО ОБЛАДНАННЯ ДЛЯ ДОГЛЯДУ ЗА РАТИЦЯМИ ВЕЛИКОЇ РОГАТОЇ ХУДОБИ

Нинішні умови утримання великої рогатої худоби в спеціалізованих промислових комплексах та великих фермах часто призводять до травматизму копит, який може в кінцевому результаті призвести до патології кінцівок. Це негативно впливає на продуктивність тварин і як наслідок завдає суттєвих економічних збитків галузі тваринництва.

Визначено декілька причин, які викликають травматизм кінцівок ВРХ та призводять до їх патології. Так, негативно впливають на ратиці тварин тверді поверхні, щільні підлоги та транспортери конвеєрного типу для видалення гною. При прив'язному утриманні корів відмічають



хвороби кінцівок до 40% тварин, тоді як в моноблочних корівниках безприв'язного типу до 90%. В молочно товарних підприємствах серед всіх механічних пошкоджень корів від 60% до 80% припадає на хвороби кінцівок викликані травматизмом копитаць ратиць і пальців.

З метою профілактики і успішного лікування захворювань ратиць у великої рогатої худоби (ВРХ) на спеціалізованих фермах та молочних комплексах потрібно вдосконалювати методи лікування, правила догляду за тваринами та способи розчистки і обрізки рогового наросту копитаць.

Обрізка та розчистка копитаць – досить трудомісткі операції, що входять до числа обов'язкових заходів з профілактики захворювань кінцівок тварин. Цю операцію проводять 2 – 3 рази на рік. При цьому зрізається надлишковий шар рогового наросту, та надається ратицям оптимальна форма. Це забезпечує рівномірний розподіл навантаження по всій опорній поверхні кінцівки.

Використовувані механічні засоби для обрізки копитаць мають деякі недоліки. Так велика маса та відсутність регулювання режимів різання залежно від фізико-механічних властивостей рогового наросту не сприяють якісній обробці копитаць.

Проведений огляд систем і обладнання для зрізання копитцевого рогового наросту у ВРХ, а особливо корів, свідчить про те що цей напрям досліджень є актуальним та перспективним.

Для підвищення продуктивності обрізки копитаць та забезпечення їхньої природної геометричної форми і необхідної шорсткості обробленої поверхні доцільно проводити подальші дослідження по обґрунтуванню конструктивно-технологічних параметрів і режимів роботи механічного обладнання для ефективного догляду за ратицями великої рогатої худоби.

Ключові слова: ратиці ВРХ, догляд за ратицями, шорсткість копитаць ратиці, механізми для обрізання копитцевого рогового наросту.

Рис. 8. Табл. 3. Літ. 8.

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