Indian Farmer
Volume 10, Issue 05, 2023, Pp. 266-269
Available online at: www.indianfarmer.net
ISSN: 2394-1227 (Online)

Popular Article

OPEN ACCESS

Importance of horns in dairy cattle

Prachi Dhaka* Avani Singh, Sunil Kumar Bhardwaj, Shivam Sharma and Pavan Kumar Mittal

Department of Veterinary Physiology and Biochemistry, Post Graduate Institute of Veterinary Education and Research (PGIVER), Jaipur, Rajasthan- 302031

***Corresponding author:** prachidhaka60@gmail.com*

Received:11/05/2023 *Published:28/05/2023*

Introduction

When envisioning dairy cattle, it is common to imagine them with their distinctive and majestic horns. These iconic features, often overlooked or even disregarded, hold significant importance in the world of dairy farming. The presence of horns in cattle is not simply a matter of aesthetics; it encompasses a range of benefits that contribute to the overall well-being and productivity of these magnificent animals. Throughout history, cattle have roamed the earth with their horns intact, honed by evolution and natural selection. Horns serve various purposes, including defense against predators, thermal regulation, and communication within the herd. However, in recent times, there has been a growing trend of removing or altering horns due to concerns related to safety, ease of handling, and potential risks to both humans and other animals. Nevertheless, a growing body of research has illuminated the multifaceted advantages associated with preserving and managing horns in dairy cattle. By embracing the significance of horns, farmers can align their practices with the inherent needs of the animals, promoting animal welfare, and ultimately reaping the benefits in terms of improved productivity and sustainability.

One crucial aspect of horns is their role in social dynamics among cattle. Horns serve as essential tools for communication and interaction within the herd. They facilitate the establishment of hierarchies, the resolution of conflicts, and the maintenance of cohesion among individuals. By respecting the presence of horns, farmers foster an environment that nurtures natural social behaviour, resulting in reduced stress levels, enhanced herd management, and minimized aggression. Moreover, the impact of horns on the overall well-being and health of dairy cattle should not be underestimated. Properly managed horns contribute to the animals physical and mental fitness, enabling them to thrive in their environment. Horns aid in thermoregulation, helping cattle cope with temperature fluctuations and maintaining optimal body temperature. Furthermore, horns play a role in grooming and self-care, allowing cattle to remove debris, itchiness, and parasites, thus contributing to their comfort and overall welfare. In addition to the animal welfare benefits, the presence of horns has been linked to increased milk production and quality. Studies have indicated that dairy cows with intact horns exhibit higher milk yields and improved milk composition compared to hornless cows. This phenomenon can be attributed to the fact that cows with horns experience lower stress levels, leading to enhanced feed intake, improved digestion, and more efficient metabolic functioning.

As the dairy industry evolves, there is an increasing emphasis on sustainable and ethical practices. Recognizing the importance of horns in dairy cattle aligns with these values, as it embraces the natural characteristics of the animals and promotes their overall well-being. By understanding and incorporating appropriate horn management techniques, farmers can optimize the potential of their herds, fostering a more harmonious and productive environment.

Horn and its structure

Horns are permanent, epidermally derived structures of hard keratin that grow on bony cores attached to the frontal bones of the skull by members of the family Bovidae. Horns are specialized keratinized structures and typically serve as weapon for defence or attack. At the base, new horn epidermal cells are inserted. A number of modified hair follicles initially form a cluster and are gradually arranged in a circle to give a tube-like shape. Horns grow out of the skull and are anchored by a bony core called the pedicle. Unlike antlers, which are shed annually, horns are permanent and continue to grow throughout the animal's life. Horns come in many shapes and sizes, and can be curved, straight, spiral, or even fork-shaped. The shape and size of the horns can vary widely depending on the species and the animals age and sex. Some animals use their

horns for defense, while others use them for foraging or to establish dominance over other members of their species.

Structure

Bovine horns consist of two parts: an outer hard keratin covering and an inner bony core.
Horn has a shock-resistant structure due to its tough and flexible properties. In cattle, the horn can withstand 7600N force in compression tests. Such mechanical pressure may be lethal in other animals. These mechanical properties of horn are a combination of the bony core and the keratinized sheath. The keratin fibers that make up the horn's sheath are arranged in a spiral pattern around the core, which helps to distribute the force of impact and prevent the horn from breaking easily. Horn absorbs and transmits the force from the keratinized layers to the fluid layer between the keratinized part and the core bone, then to the core bone and frontal sinus, and finally the muscles and bones in the neck and shoulders. Additionally, the horn is composed of layers of compacted keratin fibers, which are tightly packed together, providing strength and rigidity to the structure of the horn.

1. The integument

The horn is made up of a keratinized epidermis, dermis, and core bone from exterior to interior. The epidermis layer consists of three parts, the stratum basale, stratum spinosum, and stratum corneum, the latter of which forms the keratinized layer. In cattle, the keratin sheath is seven times tougher than the bone core. The lympho-vascular system supplies the keratinized layer, which is strongly innervated and expands throughout life. Male horns are generally larger than females. Horns can vary in length, microstructure, and shape (i.e., straight, curved, and spiral horns) depending on the species and fighting style. i.e., straight, curved, and spiral horns. The core bone periosteum in cattle is covered by the dermal papillae of the dermis. The dermis at the base of the horn fuses with the periosteum of the frontal bone and continues with it on the frontals. Despite being heavily veined and innervated, the horn dermal tissue lacks glands.

2. The core bone

The core bone is highly vascularized by branches of the corunal artery. In cattle, the exterior surface of core bone is rough, ridge, and foraminated. Due to pneumatization, the inner part of the core bone in the central cavity is spongy and contains some marrow. The Sponginess of cattle core bone is 66% at the distal end of the horn and 50% at the proximal end. This porosity gradient gives the base a higher mechanical resistance than the tip of the horn. In terms of microstructure, core bone is mainly composed of trabecular bone which has a density of 0.9g/cm^{3}in cattle horn. The outermost layer of core bone is composed of cortical bone. The trabecular bone and the porous architecture of the core bone allow for the dissipation of forces exerted during ramming. In Bovidae, the bone core is usually directly connected to the frontal bone.

3. The Pneumatization

Pneumatization refers to the process by which air sacs or cavities form within the spongy bone of core bone. In some bovine species, the frontal sinus grows into the base and body of the bone core, creating an enlarged underlying sinus (pneumatization). These air sacs are connected to the nasal passages and are believed to play a role in reducing the weight of the horns and improving their resonance for use in communication and social interaction. Additionally, the air sacs may help to dissipate heat from the animal's head, which can be important in hot climates. The degree of pneumatization in cattle horns can vary depending on the breed and individual animal. Some breeds, such as the Texas Longhorn, are known for having heavily pneumatized horns, while others may have less pronounced pneumatization.

Importance of horn (physiological, thermoregulation, and behavioural)

Horns are an important adaptation for many animals, serving a variety of functions including defense, aggression, and competition for resources such as food and mates. For example, large horns on males of many ungulate species are used for dominance and to establish a hierarchy among males during mating season.

Phylogenetic functions of horns

The phylogenetic functions of horns in dairy cattle provide valuable insights into their evolutionary significance and biological purposes. In males, the main evolutionary advantage of horns is related to intrasexual competition for mates, various hypotheses have been explored and controversy discussed. They suggest that horns may offer advantages in predator defense or in resource competition during evolution, and hypothesized that male mimicry in female cattle protects male offspring from aggression from dominant males, resulting in the prolonged presence of sons in the natal herd and in the home area. This can improve the survival and reproductive success of male offspring and thus the genetic fitness of the mother. In addition, there is evidence in male ungulates that horns serve as honest signals of genetic quality in female mate selection. It

is important to note that the phylogenetic functions of horns in dairy cattle should be considered in the context of modern farming practices and the specific needs of the industry.

Behavioural functions of horns

The main behavioural function of horns in bovine animals is for defense and territorial displays. Horns are used by males to defend their territory and establish dominance over other males during mating season. They also use them as weapons to defend themselves against predators. Horns play an important role in courtship displays and social interactions. They are used to intimidate rivals and establish dominance among members of the same species. They can also be used in self-care of areas of the body that would otherwise be unreachable. Horns also serve as a way to communicate with other members of the same species. For example, in some species, males with larger or more developed horns are more likely to be dominant and successful in mating. This can influence the behaviour of other males, who may avoid confrontations with a larger-horned male. Horns play a significant role in the social dynamics of bovine herds. Dominant individuals use their horns to assert their dominance over other members of the herd, and this can influence the distribution of resources, such as food and water.

Horns serve purposes that go beyond social behaviour. They can also be used to self-groom body parts that are otherwise out of reach. Animals appear to be well aware of their horns. Studies have reported that a cow can access extremely narrow food racks without running into each other by tilting their heads. Some farmers have reported verbally that some horned cows are even able to deliberately use the tip of their horns to open closed feeding racks.

Physiological functions of horns

The association between excellent production qualities and horn presence among cow breeders in the past seemed to be a typical occurrence. Horns were valued for selection because of their perception. A variation in the amount of animal nutrition is reflected in the variation in horn growth results horn developing a series of rings. The stress of calving cows is particularly reflected in their horns. So, it acts as an indicator of an animal's health and fitness, and can also provide information on the animal's age and sex. They also have functional uses such as helping animals to forage for food or defend themselves and their offspring. For example, many species of buffalo use their horns to dig up roots, fruits and bulbs.

Horns play an important role in thermoregulation, some authors concluded that there is no evidence of the thermoregulatory function of horns. The heat exchange area may exist between the highly vascularised double-layer area of the periosteum next to core and corium adjacent to the sheath. Both the surface area of core and thickness of insulating keratin sheath affect the amount of heat exchange through horns. Further horn core is a part of the sinus and may be related to the thermoregulatory mechanism. Therefore, horn might help with nasal heat exchange and during exhalation, this mechanism significantly reduces water loss by cooling air. Some farmers believe that the dehorned and polled cows have more digestive and lameness problems.

Disbudding and Dehorning

Within the realm of dairy farming, one practice that elicits both scrutiny and necessity is the procedure of disbudding and dehorning in cattle. Disbudding involves removing the horn buds in young calves, while dehorning entails the removal of mature horns (Stafford *et al.,* 2011). These procedures have become customary in many farming operations due to concerns over safety, ease of handling, and potential injuries to both humans and other animals. However, the ethical considerations and practical necessities surrounding disbudding and dehorning warrant a thorough examination.

Disadvantage of disbudding and dehorning

One of the most significant disadvantages of disbudding and dehorning is the inherent pain and distress inflicted upon the animals. These procedures involve the use of hot irons, caustic chemicals, or mechanical devices, all of which can cause significant discomfort, tissue damage, and lingering pain. Calves subjected to disbudding often experience acute pain and display signs of distress, such as vocalization, increased heart rate, and changes in behaviour. Even when performed under anesthesia, the recovery period can be arduous and painful for the animals. Furthermore, disbudding and dehorning disrupt the natural social dynamics within the herd. Horns serve as essential tools for communication and social interaction among cattle. With the removal of horns, the ability to establish hierarchies, resolve conflicts, and maintain social cohesion is compromised. This can lead to increased aggression, as cattle resort to alternative means of establishing dominance and asserting themselves within the group. The absence of horns may also impact the animals' ability to communicate effectively, leading to misunderstandings and potentially compromising the overall welfare of the herd.

In addition to the immediate pain and behavioural changes, disbudding and dehorning can have long-term effects on the animals well-being. The removal of horns disrupts the natural balance of the animal's body, affecting their thermoregulation capabilities. Horns play a crucial role in dissipating heat, allowing cattle to regulate their body temperature more effectively, particularly in hot climates. Without horns, cattle may struggle to cope with temperature fluctuations, leading to increased stress, reduced feed intake, and potentially compromising their overall health and productivity. The negative consequences of disbudding and dehorning are not limited to animal welfare; they also pose challenges for farmers and farm management. These procedures can be time-consuming, labor-intensive, and require skilled personnel to perform them safely and effectively. The risk of complications, such as infections or excessive bleeding, is present, and additional veterinary care may be needed to manage these issues. The financial costs associated with these procedures, including equipment, anesthesia, and veterinary services, can add up significantly, impacting the profitability of the farm. Moreover, the practice of disbudding and dehorning has faced growing scrutiny from consumers and regulatory bodies concerned with animal welfare. Increasingly, there is a demand for more ethical and sustainable farming practices that prioritize the well-being of animals. The removal of horns can be seen as a departure from these values, potentially leading to negative public perception and affecting the reputation and marketability of dairy products.

Conclusion

In conclusion, the importance of horns in dairy cattle cannot be understated, as they play a crucial role in the animal well-being, behaviour, and productivity. Horns facilitate communication, thermoregulation, and self-care, contributing to the overall health and comfort of the cattle. However, the practice of disbudding and dehorning, while often driven by practical necessities, presents significant disadvantages. These procedures can cause pain, distress, and long-lasting negative effects on the animals. Disrupting the social dynamics within the herd and compromising the animals' ability to regulate their body temperature effectively are additional drawbacks. Responsible farming entails a delicate balance between the practical considerations and ethical implications of disbudding and dehorning. Furthermore, advancements in handling techniques, training programs, and farm infrastructure can help mitigate the risks associated with horned cattle, reducing the necessity for disbudding and dehorning. By implementing appropriate husbandry practices and optimizing herd management strategies, farmers can create a safe and comfortable environment for the animals.

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