

A Review on Cranial Appendages of Ruminants

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Abstract: Ruminant mammals use cranial appendages mostly for defense and sexual attraction. Cranial appendages have different shape and size according to species *viz.* straight, spiral, curved, bent, flat, flipped, short, wide, long *etc.* Out of six extant families of ruminants, four families possess these cranial appendages *viz.* Cervidae, Bovidae, Antilocapridae and Girrafidae. Tragulidae and Moschidae do not possess it. Cranial appendages of Cervidae is called antlers, cranial appendages of Bovidae is called horns, cranial appendages of Girrafidae is called ossicones and cranial appendages of Antilocapridae is called pronghorns. Usually horns of Bovidae is called true horns with a bony core surrounded by keratinous epithelium, which usually occurs in both sexes and are unbranched, tapering and cylindrical. True horns are permanent structures, grow throughout the life and never shed. Antlers of Cervidae are branched and found only in males except Reindeer (*Rangifer tarandus*). Antlers are covered with vascular skin called velvet which shed after breeding season.

Keywords: Ruminants, Cranial appendages, Horns, Bovidae, Keratin, Antlers

I. Introduction:

In mythology horns are associated with demons but in reality they are associated with herbivory. Ruminants are artiodactyls mammals. They are herbivores and possess special process of rechewing the cud called rumination. Darwin was first to suggest that horns evolved for sexual selection. Cranial appendages have different shape and size according to species *viz.* straight, spiral, curved, bent, flat, flipped, short, wide, long *etc.* Ruminant mammals use cranial appendages mostly for defense and sexual attraction. Out of six extant families of ruminants, four families possess these cranial appendages *viz.* Cervidae, Bovidae, Antilocapridae and Girrafidae. Tragulidae and Moschidae do not possess it [1]. Cranial appendages of Cervidae is called antlers, cranial appendages of Bovidae is called horns, cranial appendages of Girrafidae is called ossicones and cranial appendages of Antilocapridae is called pronghorns. All cranial appendages are internally projections of frontal bones of skull and may be naked or covered with keratin or skin. Usually horns of Bovidae is called true horns with a bony core surrounded by keratinous epithelium, which usually occurs in both sexes and are unbranched, tapering and cylindrical. True horns are permanent structures, grow throughout the life and never shed [2]. Antlers of Cervidae are branched and found only in males except Caribou and Reindeer. Antlers are covered with vascular skin called velvet which shed after

breeding season. Antlers are covered with vascular skin which supplies oxygen and nutrients to the growing bone. Once the antler achieves its proper size the velvet is lost and the antler's bone dies. This dead bone structure is antler and it shed after each mating season due to hormone fluctuation. Ossicones of Girrafidae are stunted, unbranched and found in both sexes. Pronghorn of Antilocapridae shed every year and bears one to three prongs. Exact origin of cranial appendages is unclear. After death of horned animal, keratin is usually consumed by larvae of horned moth.

II. Results and Discussions:

Bovidae (sheep, cattle, buffalo, bison, antelope *etc* includes 137 extant species, out of which 79 extant species are found in Africa [3]. Some mammals with distinctive and noticeable headgears are Markhor, Saiga, Nubian Ibex, Bharal, Addax, Blackbuck, Giant Eland, Moose, Caribou, Asian Water buffalo *etc*. Many non mammalian animals too have cranial appendages too. Jackson's Chameleon (*Triceros jacksonii*) has horns on their skull with keratin cover. Horned lizard (*Phrynosoma*) also has horn. Some insects like Rhinoceros beetle (Dynastinae) have horn like structures on the head. These are outgrowth of hard chitinous exoskeleton. Golden Jackal (*Canis aureus*) rarely develops a tiny growth on the skull. Some extinct reptiles like Triceratops and theropods were also with horns. Some suggests that cranial appendages are showing this reptilian ancestry. In rare cases animals have small horny growths in the skin where their horns would be known as scurs. There is also a well known case of horns of Rhino. They are fibrous horn made of only keratin, attached on rough area of nasal bone. They are permanent and regenerative structures. Indian Rhino (*Rhinoceros unicornis*) has a single horn while the African Rhino (*Diceros bicornis*) has two one behind the other.

Horns are not primarily connected to skull and fuse secondarily to the frontal bone, while antlers grow from pedicles at the sides of frontal bone. Antlers continue to grow as spongy bone which is later replaced by compact bone [4]. Horn covering are made of keratin produced by keratinocytes. Mammals are able to produce α -keratin, while reptiles and birds can produce both α and β keratins. Bony part of horns is composed of calcium and phosphate. Castration cause the loss of horns indicates that testosterone is important in maintenance of horns. Keratin is composed mainly of two amino acids *viz.* Glycine and Cysteine. It also includes two elements *viz.* Sulfur and Nitrogen. Keratin usually mineralized less than 1%. This biopolymer has high mechanical efficiency but is much lighter than bone and teeth [6].

There are many hypotheses for the function of horns. First hypothesis is that they are used for defense from predators and intraspecific competition. Males who win fights obtain a territory and dominance in a herd. Second hypothesis is that they used for courtship display to attract females and help in sexual selection. Third hypothesis is they used to establish social hierarchy. Fourth hypothesis is that they used in thermoregulation and act as radiator. Fifth hypothesis is that they are used as hearing aids by

acting as parabolic reflector. Sixth hypothesis is that they are used in species recognition. Seventh hypothesis is that they are case of atavism showing reptilian ancestry.

Some researchers suggest that ornamental traits like horns seemed to evolve at much faster rate than other traits. Some study also suggests that ruminants living in open area are more likely to have horns to protect themselves in comparison to ruminants that live in dense ambush vegetation. Some studies suggest that morphology and diversity of horns and fighting behavior are associated [5]. Some researchers believed that due to herbivorous diet that canines became reduced and to compensate them they evolved these appendages as a weapon to protect them and their territory. Some says that there is a negative correlation between tusk and cranial appendages. It is based on the fact that mammals having headgears does not usually possesses tusks. Explanation of female cranial appendages is given that; they would help to protect the young ones.

III. Conclusions:

Cranial appendages are definitely evolved for protection from predators, mating selection and intraspecific competitions. Their sexual dimorphism indicates it is sex influenced trait regulated by hormones. In absence of any weapon like nails, claws, sharp teeth *etc* they evolve this defensive weapon to protect themselves against large predators that would attack them on head directly but later predators evolved to attack on neck so they remains and became tools for mating selection and intraspecific competition and play. Different structures in different species are due to divergent evolution in their shape and size due to different environment and different selective pressure.

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