

**MIDDLE MIOCENE ELACHISTOCERAS (BOVIDAE: MAMMALIA) FROM CHINJI FORMATION OF PAKISTAN: NEW REMAINS**

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**ABSTRACT**

New fossils of a small bovid are collected from the Chinji Formation of the Potwar Plateau, northern Pakistan. The fossils are assigned to *Elachistoceras khauristanensis*, based on the morphometric analysis. *Elachistoceras* is one of the smallest and a rare record of bovid species from the Siwaliks. This contribution presents additional anatomical and morphometrical information about the horn core of the smallest Miocene bovid *E. khauristanensis*.

**Keywords:** Vertebrates, Boselaphini, Miocene, Siwaliks, Paleontology.

**1. INTRODUCTION**

Remains of *Elachistoceras khauristanensis* are found from the Lower and Middle Siwalik Subgroups and it was a boselaphine having four horns (Thomas, 1977). The horncore morphology of this extinct species quite resembles to an extant boselaphine, *Tetracerus quadricornis*. *T. quadricornis* is abundant in the open lands of Indian subcontinent, testifying the paleontological antiquity of *E. khauristanensis* (Thomas, 1977). *E. khauristanensis* consists of the genus name composed from the Greek *Elachistos* which means “smallest” and *ceras* means “horn”. The species name composed of *Khaur*, “name of important and large village”, the link *i* vowel represents “Indo-European root” and *stan* means “country”.

The new material is explored from the two sites of district Chakwal, Punjab, Pakistan, namely Dhok Bun Amir Khatoon (DBAK) and Chinji Rest House (Fig 1). The outcrops at these sites correspond to the Chinji Formation (Colbert, 1935; Cheema et al., 1997; Cheema, 2003). This Formation has predominantly brick to brightly red colored clays (70%), and subordinate sandstone and conglomerates. The color of sandstone is ash to bright gray and it is fine to regular grained. This Formation ranges from 14.2 to 11.2 Ma (Barry et al., 2013; Flynn et al., 2016). DBAK village (Lat. 32° 47' N; Long. 72° 55' E) is situated in the northeast of the tehsil Choa Saidan Shah, district Chakwal, Punjab, Pakistan (Figure 1). The considered localities are positioned on the west of the DBAK village. The exposed deposits extend in an area of few hundred square meters. The sediments (sandstones, siltstones and shales) were deposited in riverine environment, and are undisturbed igneous mineral in most cases (Cheema et al., 1997; Samiullah et al., 2012; Khan et al., 2017).

Chinji Rest House locality (Late. 32° 40' N; Long. 72° 22' E) is positioned 3 km in the south of the Chinji village, district Chakwal, northern Pakistan (Fig 1). The site consists of siltstone and sandstone. The silts differ in color from brown to yellow and gray to tan whereas the sandstone is bluish gray to brownish gray. The sandstone shows dominancy over clays and fossil remains are abundant in these rock layers. The clays are slightly compact having nodules but mostly lack

fossils. The outcrops have 750 m thickness at the Chinji type locality (Willis and Behrensmeyer, 1994). The sediments signify the typical Chinji fauna (Dehm, 1963; Barry et al., 2002; Cheema, 2003).

These Middle Miocene sites of the Lower Siwaliks have produced enormous vertebrate fossils including bovids (Pilgrim, 1913, 1937, 1939; Colbert, 1935; Dehm, 1963; Sarwar, 1977; Akhtar, 1992; Samiullah, 2010; Asim et al., 2020). But a few researchers reported *E. khauristanensis* (Thomas, 1977, 1984; Akhtar, 1992; Ali et al., 2012; Khan et al., 2013; Babar et al., 2013; Abbas et al., 2018). So, every new specimen adds valuable knowledge about the rare record of bovid species from the Siwaliks.

## 2. MATERIAL AND METHODS

Three specimens of tiny bovid including one horn-core and two upper molars were sampled from the outcrops of DBAK and Chinji Rest House, district Chakwal, Punjab, Pakistan (Fig 1) and displayed in Dr. Abu Bakr Fossil Display and Research Centre, Institute of Zoology, University of the Punjab, Lahore, Punjab, Pakistan. Hardly adjoined sediments were removed by using geological tools like needles and brushes. Broken parts assembled with Elfy.

After washing and cleaning, the material was prepared and studied for taxonomic determination. Then the specimens were observed with hand lens to describe their morphology. The specimens were catalogued with yearly catalogued number placed as numerator and serial catalogued number as denominator (*e.g.*, 17/220). The measurements in millimeters (mm) were taken by a metric Vernier caliper. The systematics follow Thomas (1977), and horn-core and dental terminology follow Gentry and Hooker (1988).

### Abbreviations

Dhok Bun Amir Khatoon (DBAK); million years (Ma); upper molar (M); millimeters (mm); Geological Survey of Pakistan (GSP); Palaeontological Collection of Government College University Faisalabad (PC-GCUF); Punjab University Paleontological Collection (PUPC); Yale Geological Survey of Pakistan (Y-GSP).

## 3. SYSTEMATIC PALAEONTOLOGY

Order Artiodactyla Owen, 1848

Family Bovidae Gray, 1821

Subfamily Bovinae Gray, 1821

Tribe Boselaphini Knottnerus-Meyer, 1907

Genus *ELACHISTOCERAS* Thomas, 1977

*Elachistoceras khauristanensis* Thomas, 1977

### Holotype

GSP 4262, a left horn-core, which lacks the apex, with the frontal fragment (Thomas, 1977).

### Type locality

Ganda Kas (Y-GSP 182), Chakwal, Punjab, Pakistan (Thomas, 1977).

### Diagnosis

As in Thomas (1977).

### Stratigraphic range

Lower to Middle Siwaliks (Thomas, 1977, 1984; Akhtar, 1992; Khan et al., 2009; Ali et al., 2012; Babar et al., 2013; Abbas et al., 2018).

*New material with locality:*

PUPC 17/220, left horn-core (Chinji Rest House); PUPC 16/143, rM2 (DBAK); PUPC 16/139, rM2 (DBAK).

*Description*

*Horn-core:* PUPC 17/220 is a fragment of juvenile left horn-core (Fig 2 (1)). The keel is thin and incipient and small furrows are found at the anteroposterior side. The horn-core is slightly rounded laterally that results in oblong cross section. The preserved length is 26.76 mm.

*Upper dentition:* PUPC 16/143, a right second molar, moderately worn (Fig 2 (2)). The cingulum is found near the base of preprotocrista and posthypocrista. The tooth has tubercle like entostyle and prominent styles and paraconus rib. The parastyle and mesostyle are divergent. The fossettes are tiny and crescentic. PUPC 16/139 is a partially damaged right second molar (Fig 2 (3)). The apices of parastyle and metacone are partially broken. The tooth has strong styles, slim but prominent paraconus rib and deep and narrow fossettes. At the lingual side, a small fragment of jaw is present with well preserved roots.

#### **4. COMPARISON AND DISCUSSION**

The morphology of the described horn-core differs from other Middle Miocene bovids like *Tragoportax*, *Miotragocerus* and *Eotragus*, in having small size and incipient keel. The size of this studied horn-core can be effectively compared with the paratypes (GSP 7326, GSP 7037) of *E. khauristanensis* described by Thomas (1977; Table I). Based on the horn core rectilinearity, small size, simple conical form, oval section and a straight axis (Fig 2 (1)), the studied specimens are confidently assigned to *E. khauristanensis* (Thomas, 1977; Akhtar and Nayyer, 2001). There is a close similarity between the horn cores of *Elachistoceras* and subadult horn cores of *Gazella* in size and shape. However, *Elachistoceras* differs from the subadult horn cores of *Gazella* in circular cross section, large anteroposterior diameter and rapid reduction to the apex instead of forming an acute pointed tip (Thomas, 1977).

The dental morphological characteristics like brachydonty, well-developed styles and ribs, rugosity in enamel, and definitely convex rough lingual wall, placed the studied dentition in small boselaphines (Pilgrim, 1937, 1939; Thomas, 1977, 1984; Gentry et al., 1999; Khan et al., 2009; Ali et al., 2012; Khan et al., 2013; Babar et al., 2013; Abbas et al., 2018). The absence of post interlobe in the studied upper molars associate them to *Elachistoceras* and make them different from that of *Tetracerus quadricornis*. Based on the morphological characters (Fig 2 (2,3)) and measurements (Table II; Fig 3), the studied molars could be associated to *E. khauristanensis*. This species of bovid is recognized from the Lower to Middle Siwaliks of Pakistan (Thomas, 1977; Akhtar, 1992; Ali et al., 2012; Babar et al., 2013; Khan et al., 2013; Abbas et al., 2108).

The Chinji *Elachistoceras* sp. is more primitive than that of Nagri but both have almost the same size (Ali et al., 2012; Khan et al., 2013). It is considered that the size of *Elachistoceras* remained the same during the Chinji and Nagri formations (Babar et al., 2013; Khan et al., 2013). Various boselaphine taxa like *Tragoportax*, *Miotragocerus*, *Helicoptax* and *Elachistoceras* existed during the Middle Miocene age of the Lower Siwaliks. The boselaphines

exhibit remarkable abundance and diversity in the Middle Miocene of the Lower Siwaliks subgroup (Khan et al., 2013). Thomas (1977) has suggested a close similarity between the *E. khauristanensis* and *T. quadricornis*

## 5. CONCLUSIONS

*E. khauristanensis*, a tiny bovid, is testified from the Middle Miocene age of the Chinji Formation of Potwar Plateau, Pakistan. The horn-core represents simple conical form, oval section and a straight axis. The upper molars show brachydonty, developed styles and ribs, rugose enamel, convex lingual wall and absence of post interlobe.

### *Conflict of interest*

The authors have stated no conflict of interest.

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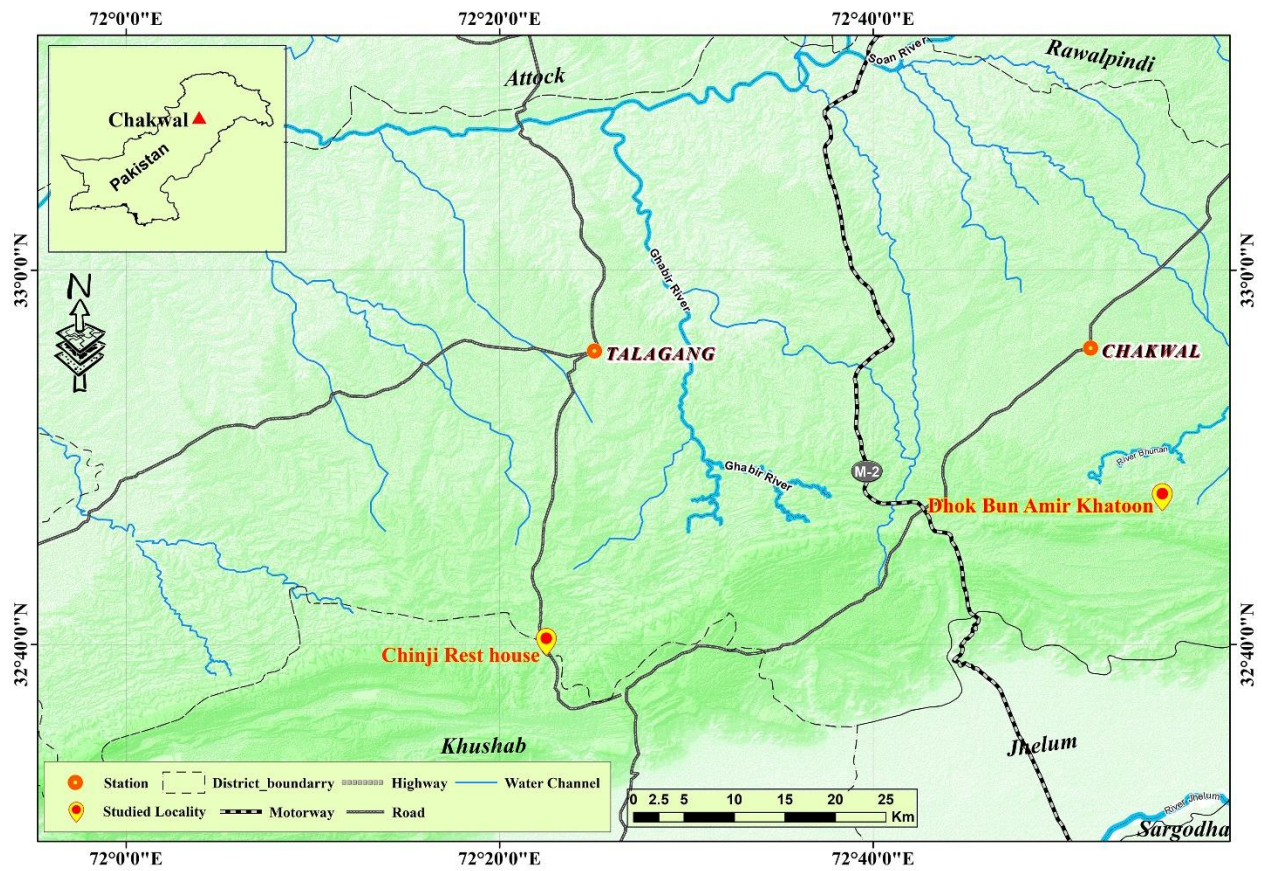
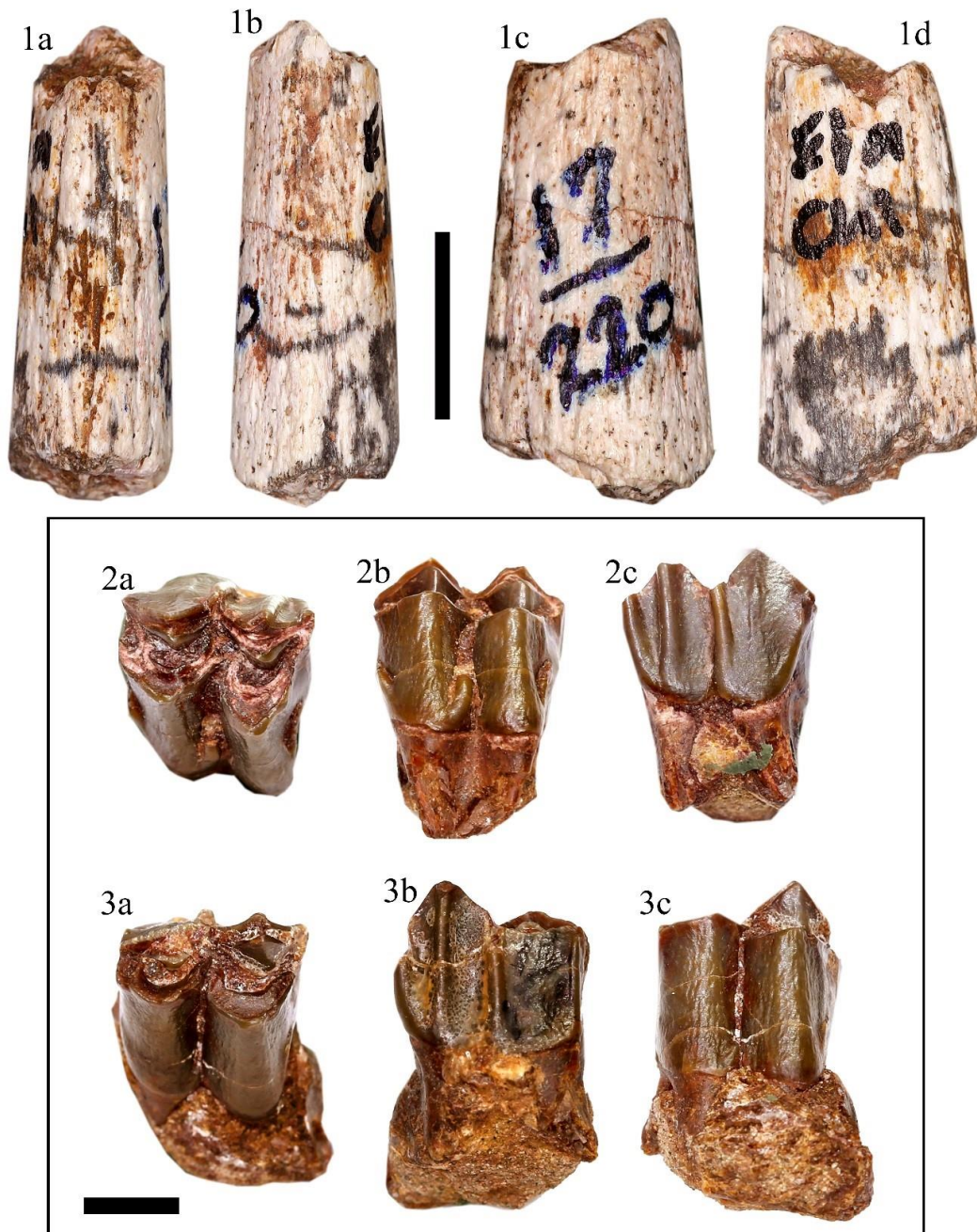
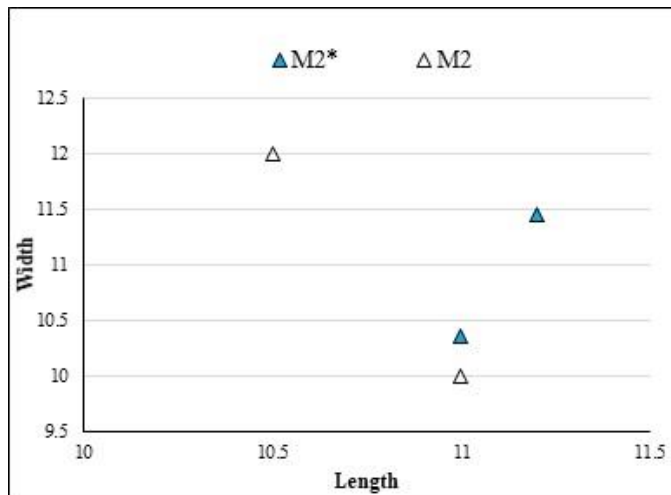


Fig 1. Map showing the studied sites of Chinji Formation of Pakistan.



**Fig 2.** *Elachistoceras khauristanensis*: **1.** PUPC 17/220, left horn-core; views: a) anterior, b) posterior, c) lateral, d) medial. **2.** PUPC 16/143, rM2. **3.** PUPC 16/139, rM2. Views: a) occlusal, b) lingual, c) labial. Scale bar 10 mm.





**Fig 3.** Dental proportions of *E. khauristanensis*'s material from the Siwaliks. \*new specimens. Comparative material from Khan *et al.* (2013) and Abbas *et al.* (2018).

**Table I:** Measurements (in mm) of *Elachistoceras khauristanensis* horn-cores. \*new specimen. Comparative material from Thomas (1977), Babar (2017).

| Inventory No.       | DAP   | DT    |
|---------------------|-------|-------|
| PUPC 17/220*        | 12.75 | 9.21  |
| GSP 4262 (Holotype) | 9.90  | 9.20  |
| GSP 7326 (Paratype) | 11.60 | 9.00  |
| GSP 7037 (Paratype) | 11.30 | 9.00  |
| PUPC 15/338         | 14.05 | 11.05 |

**Table II:** Measurements (in mm) of *Elachistoceras khauristanensis* teeth. \*new specimens. Comparative material from Khan *et al.* (2013), Abbas *et al.* (2018).

| Inventory No.  | Nature & Position | Length | Width | W/L  |
|----------------|-------------------|--------|-------|------|
| PUPC 16/143*   | rM2               | 11.20  | 11.45 | 1.02 |
| PUPC 16/139*   | rM2               | 11.00  | 10.35 | 0.94 |
| PC-GCUF 11/78  | lM2               | 10.5   | 12    | 1.14 |
| PC-GCUF 11/126 | rM2               | 11     | 10    | 0.91 |