A NEW COLLECTION OF *GIRAFFOKERYX PUNJABIENSIS* (GIRAFFIDAE, RUMINANTIA, ARTIODACTYLA) FROM THE LEHRI OUTCROPS, JHELUM, NORTHERN PAKISTAN

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ABSTRACT: Some new remains of *Giraffokeryx punjabiensis* in the Lehri outcrops (Chinji Formation, Lower Siwaliks) of the district Jhelum, northern Pakistan is identified and compared in this paper. The recovered dental material includes the lower dentition and preserves enough to elaborate the taxonomic characteristics. The molars exhibit straight-line conids, narrow crowned, fine enamel sculpture and weak stylids/median ribs. The morphological and metrical characters of the specimens are described and their systematic determination is discussed in here. *Giraffokeryx punjabiensis* is known only from the Middle Miocene sediments of the Siwaliks and Greco-Iranian province. The presence of *G. punjabiensis* in the Lehri outcrops advocates that the sediments date to Middle Miocene.

Key words: *Giraffokeryx punjabiensis*, Chinji, Lehri, Siwaliks, giraffids.

INTRODUCTION

Giraffokeryx lived in the middle Miocene fresh water deposits of Eurasia (Colbert, 1935; Geraads and Aslan, 2003; Geraads *et al*., 1995). The earliest well-accepted giraffid, *Palaeotragus primaevus*, comes from the middle Miocene of Africa (Kostopoulos and Sarac, 2005). An independent evolution of the giraffids probably took place in Africa from that in Eurasia (Gentry, 1993). The giraffid started their history in the early Miocene. They appeared in the early Miocene sediments of central Asia from where they dispersed to Europe most probably in the Middle Miocene. The first appearance of giraffids in Africa is reported in the Miocene sediments (Romer, 1974; Gentry, 1993). The giraffids record in South Asia begins from the early Miocene times, from where they later dispersed to the Southeast Asia (Khan and Umar, 2006). However, Giraffidae has a rich fossil history consisting of thirty species throughout the Neogene of the Old World (Bohlin, 1926; Hamilton, 1978; Geraads, 1986; Janis and Scott, 1987; Gentry and Hooker, 1988). Giraffids made their appearance in the Kamlial Formation of the Siwaliks (Raza *et al.*, 1984) nevertheless they remain poor in quality but relatively abundant in quantity in the lower part of the Chinji Formation.

The studied material comes from the sediments of the Lehri (lat. 33° 31' 60" N, long. 73º 32' 60" E), district Jhelum; with average thickness around this area is about 633 m (Fig. 1).

The exposed sediments of the study site are composed mostly of red shale with subordinate light gray to ash gray sandstone which is the characteristics of the

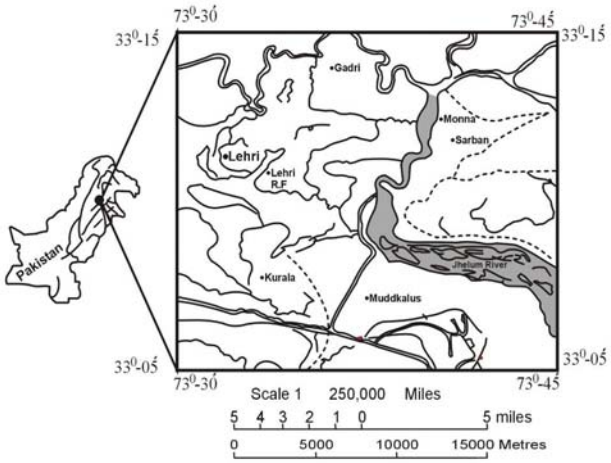

Fig - 1: Location of the study section, the Lehri and the surrounding localities (modified from Akhtar and Bajwa, 1984).

Chinji Formation (11.2 to 14.2 Ma). The sandstone is fine to medium grained, sometimes gritty, unsorted and cross-bedded. The proportion of shale and sandstone varies from place to place. Scattered pebbles and conglomerates along some palaeochannels are present along different horizons of the Formation (Akhtar and Bajwa, 1984) (Iqbal *et al*., 2009). Sandstones are rather hard, well bedded, jointed and sometimes show primary sedimentary features like various types of cross-bedding. Argillites constitute the predominant facies of the Formation. This set of deposits usually assigned to the Chinji Formation (Badgley and Tauxe, 1990).

MATERIALS AND METHODS

The outcrops of the Lehri village (Chinji Formation) district Jhelum, Punjab Pakistan, were thoroughly investigated in order to obtain the middle Miocene giraffid specimens. In due course numbers of field trips were carried out to the various fossilized sites of the Lehri village (Chinji Formation) and the buried specimens were dug out with the help of the light hammers, chisels and fine needles. The specimens were transported to the Palaeontology Laboratory of Zoology Department, Government College University Faisalabad for the taxonomic study and subsequently, the fossils were acquired after cutting off the excessive sand stone by an electric cutter.

Some of the specimens were not in well preserved condition. They were thoroughly washed and cleaned in the laboratory and prepared for the study. In the laboratory, fine needles and brushes were used to remove sediments. Broken parts were assembled by using various types of gums (resins) such as Araldite, Magic stone, Elfy, Elite and Fixin.

The measurements of the specimens were taken in millimeters with the help of metric Vernier Caliper (Khan *et al*. 2009). The morphological and metrical characters of the specimens are described and their systematic determination is discussed. The catalogue number of the specimens consists of series i.e., yearly catalogued number and serial catalogue number, so figures of the specimen represent the collection year (numerator) and serial number (denominator) of that year (e.g. 09/12).

Uppercase letters with subscript number stand for lower dentition (e.g. M_1). PC-GCUF and PUPC are institutional abbreviations for the Palaeontological Collection Government College University, Faisalabad and the Palaeontological Collection of Punjab University, Lahore respectively. The terminology of the tooth crown elements and manners of measurements follow Gentry (1994).

SYSTEMATIC PALAEONTOLOGY

Family GIRAFFIDAE Gray, 1821
Subfamily PALAEOTRAGINAE Pilgrim, 1911
Genus *GIRAFFOKERYX* Pilgrim, 1910

Giraffokeryx punjabiensis Pilgrim, 1910

Referred Material: PC-GCUF 09/23 – a fragment of right mandibular ramus with P_4-M_1; PC-GCUF 09/24 – a fragment of left mandible having P_2, P_4 and M_{1-3}.

Description: PC-GCUF 09/23 is a well preserved right mandibular ramus with P_4-M_1, other portion of the dentary is missing (Fig. 2A). The ramus is moderately deep vertically and thick horizontally. The mandibular ramus is sandwiched in the sandstone but the premolars are exposed enough to study the taxonomic features.

PC-GCUF 09/23 is well preserved lower fourth premolar and in middle wear (Fig. 2A). The P_4 has the paraconid well separated from the parastylid. The enamel is thick and rugose. The rugosity is more prominent on the lingual side than on the buccal side. The enamel is wrinkled and the wrinkles are more evident on the labial side. This difference was caused by the action of weathering on the lingual side of the tooth. The cingulum is moderately developed anteroposteriorly. The metaconid extend forwards meeting the base of the paraconid. The crest joins to the metaconid and incorporates the entoconid. The entoconid is independent from the metaconid in early wear. A well developed furrow separates the hypoconid from the strong protoconid on the buccal side.

The occlusal outline of the molar is nearly rectangular (Fig. 2A). The crown is labially and lingually flattened. The major conids are well preserved. Among all the conids the metaconid is largest while entoconid is smallest. The protoconid is well preserved and the metaconid is relatively higher than the protoconid. Para and mesostylids are weakly developed. Fossettes are moderately developed. The narrow central cavity filled with matrix is present. The metaconid is expanded lingually. The parastylid is thinner than in P_4. The anterior lobe is large and closed lingually.

PC-GCUF 09/24 is fairly preserved left mandibular ramus with P_2, P_4 and M_{1-3}, while P_3 is missing (Fig. 2B). The lingual side of the mandibular ramus is embedded in the compact sandstone which prevents to study the diagnostic features of the mandibular ramus lingually. The embedded sandstone is too hard to remove. Therefore, the taxonomic study and the measurement of the specimen is based on the exposed buccal side. The ramus is thick transversely. The anterior and the posterior portions of the ramus are fragile, and the ascending ramus is damaged particularly.

The second premolar is badly damaged and poorly preserved (Fig. 2B). Only the buccal side is visible as the lingual side is embedded in the sandstone. The tooth is brachydont and is in middle stage of wear. The enamel is moderately thick and wrinkled. The cingulum is poorly developed. The transversal cristids are very short, no postprotoconulidcristid and no metaconulid. The fourth lower premolar is poorly preserved and badly damaged like the second premolar. It is in the middle stage of wear and brachydont. The major conids are not preserved but the entoconid. The premolar is broken anteriorly while it is somewhat preserved posteriorly.

The first molar in the mandible is well preserved but its lingual side is embedded in the sandstone (Fig. 2B). It is in the middle stage of wear. The enamel is moderately thick, rugose and shows fine plications on the buccal side. The cingulum is moderately developed. The

major conids are fairly preserved and crescentic in their shape. The entoconid and the metaconid are well preserved. They are pointed in the middle with the two anterior and posterior sloping ridges. The apices of the protoconid and the hypoconid are sharp and they are quite crescentic in shape. The stylids are well developed and more evident at the summit of the crown of the tooth. The ribs are narrow and the fossettes are moderately developed.

The second molar in the mandible of the specimen is badly damaged and partially broken (Fig. 2B). The lingual side is completely embedded in the matrix and it is invisible. The major conids are not well preserved. The protoconid and the hypoconid are well preserved. They are pointed sharply in the middle with the two anterior and posterior sloping ridges. The preprotocristid is smaller than the postprotocristid. The prehypocristid and the posthypocristid are almost equal in length. The third molar in the mandible of the specimen is fragile, pretty damaged and partially broken (Fig. 2B). The major conids are badly damaged. The mandibular ramus is right broken after the anterior conids of the molar however it is emended in the laboratory. The protoconid and the hypoconid are emended. The talonid is not fully erupted.

DISCUSSION

The studied specimens include brachydont teeth and these may be referred to some tylopods or ruminants. Since the specimens have very rugose enamel and this fine rugosity is not seen in any tylopods so they cannot referred to any of the tylopods. In ruminants, such a fine rugosity is the characteristic of the giraffids only (Pilgrim, 1911a,b). The Siwalik giraffes may be placed in three subfamilies i.e. Paleotraginae, Sivatheriinae and Giraffinae. Paleotraginae comprises the genus *Giraffokeryx.* Sivatheriinae includes the genera *Sivatherium, Bramatherium, Helladotherium* and *Hydaspitherium.* Genus *Giraffa* is placed in the subfamily Giraffinae. These three subfamilies emerged simultaneously but their migration to the Siwalik region occurred at different times. Palaeotragines and Giraffines came earlier than the Sivatheriines (Akhtar *et al.,* 1991).

The Siwalik giraffids may be divided into two groups, one consists of the large forms and the other small forms (Akhtar and Sarwar, 1987). The smaller forms include the genera *Giraffokeryx* and *Giraffa*, while the larger forms include the genera *Bramatherium*, *Hydaspitherium*, *Sivatherium*, *Helladotherium* and *Vishnutherium.*

The studied specimens (PC-GCUF 09/23 and PC-GCUF 09/24) show the typical characteristic of the giraffid lower premolars and molars. The specimens have characteristic depth of the central enamel folds, enamel layer rugosity and shape of the major conids. As the teeth are brachydont and small sized they can either be compared with the genus *Giraffokeryx* or the genus *Giraffa,* or can be excluded to the large siwalik giraffids. It may be referred to the genus *Giraffokeryx* because of its following features: The major conids are in straight line. These are in a straight line in genus *Giraffokeryx* (Pilgrim, 1911a). Enamel sculpture is fine. The enamel sculpture is rough in the genus *Giraffa* (Pilgrim, 1911a).

Morphometrically (Table 1) PC-GCUF 09/23 resembles with already studied specimens of *Giraffokeryx punjabiensis* (Bhatti, 2005; Colbert, 1935). They have almost same in the anteroposterior length and the crown width. The minor difference is due to the individual variations. The lower premolars are very close to the species *Giraffa punjabiensis* regarding the size. The external folds are much developed in the *Giraffa punjabiensis*, whereas the stylids are weakly developed in the studied premolar. It also shows the typical morphology of the species *Giraffokeryx punjabiensis*.

The PC-GCUF 09/24 resembles with PUPC 2002/06, PUPC 02/19, PUPC 02/12, AMNH 19849, AMNH 19317 and AMNH 19587 (identified as *Giraffokeryx punjabiensis* by Bhatti in 2005 and Colbert in 1935 respectively) in the anteroposterior length and the crown width (Table 1). Regarding the size among the known Siwalik giraffids these lower molars are very close to species *Giraffa punjabiensis*. The external folds are much developed in the lower molars of the *Giraffa punjabiensis*, whereas the stylids and the median ribs are

Table-1: Comparative measurements of the cheek teeth of *Giraffokeryx punjabiensis* in mm (millimeters). * The studied specimens. Referred data is taken from Bhatti, 2005 and Colbert, 1935.

Number	Position	Length	Width
PC-GCUF 09/23*	P_4	31	21
	M_1	30	22
PC-GCUF 09/24*	P_2	11.5	8.6
	P_4	12.7	9.4
	M_1	29	11
	M_2	31.1	13.6
	M_3	ca. 35	ca. 14.7
PUPC 02/12	M_3	34.0	18.0
PUPC 02/19	M_3	30.0	19.0
PUPC 2002/06	P_2	16.0	9.0
	P_4	23	14.5
AMNH 19317	M_3	37.0	18.0
AMNH 19849	M_3	35.0	15.5
AMNH 19587	P_2	18.0	9.0
	P_4	24.0	15.0
	M_1	24.0	16
	M_2	25.0	17
AMNH 19323	P_3	20	12

less pronounced in the studied specimens which is the characteristics of species *Giraffokeryx punjabiensis*. All the characteristics correspond to species *Giraffokeryx punjabiensis* of the Siwalik *Giraffokeryx* and can reasonably assigned to the same species.

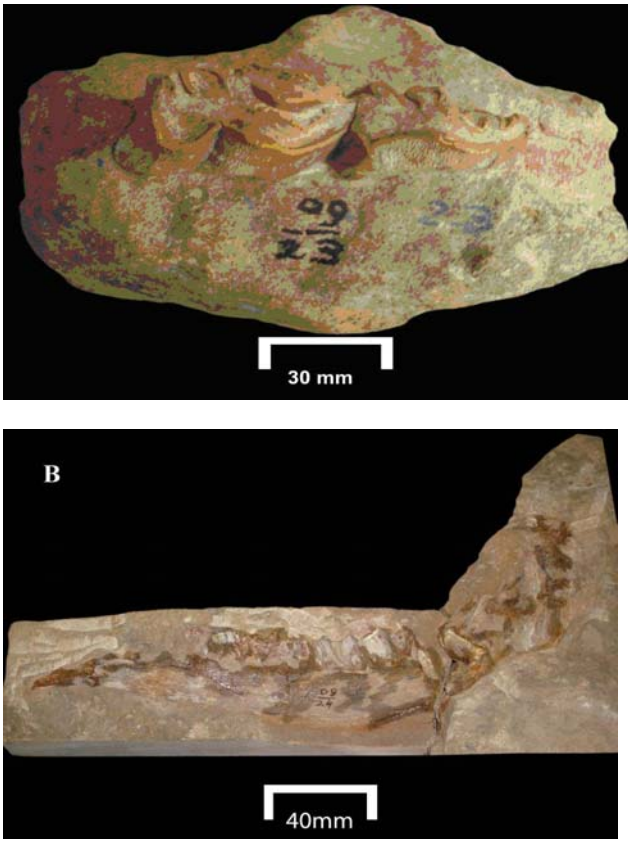

Fig. 2: A, PC-GCUF 09/23 – lower right mandibular ramus having P_4-M_1 (occlusal view); B, PC-GCUF 09/24 – lower left mandibular ramus with P_2, P_4 and M_{1-3} (buccal view).

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