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Fossil Study of Pigs (Family Suidae) from Litra-Chaudhwan Formation of Sulaiman Range

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ABSTRACT

Dharab locality of Sulaiman Range near Sakhi Sarwar Tomb is highly fossiliferous in Litra- Chaudhwan formations, dated from the Late Miocene to the Early Pliocene of Middle Siwalik of Pakistan. Fossils of this locality are reported as bovids, tragulids, rhinocerotids, girafids, suids, and proboscideans. The present study emphasizes the Suidae family and the collected specimen is similar to *Propotamochoerus hysudricus*. This species is extinct with a moderately sized body and large cheek teeth. The specimen discussed from this locality is reported for the first time in this article and is a virtuous addition to the Paleontological field. This material broadens our findings for the evolution and diversification of *Propotamochoerus hysudricus* (Suidae) in the Sulaiman Range of Pakistan.

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SI and MF planned this study. MS and MF executed the experimental work and analyzed the data. SI and MF wrote the article. AG reviewed and proofread the article.

Key words
Sulaiman Range, Sakhi Sarwar, Suidae, Litra formation, Chaudhwan formation

INTRODUCTION

Suidae represents one of the most critical taxa from the economic point of view in the order Artiodactyla. Furthermore, it is essential owing to its substantial contribution to the evolutionary linkage of mammals between demand Artiodactyla and Cetacea (Pickford, 1993). It is a diversified group in terms of species and has been studied by numerous scholars (Falconer, 1868; Lydekker, 1883; Pilgrim, 1926; Colbert, 1935; Pickford, 1988; Batool *et al*., 2015). The Suidae family was reported in Eurasia and Africa in the past with numerous genera (Kostopoulos and Sen, 2016; Pickford and Obada, 2016; Spassov *et al*., 2018; Mors *et al*., 2019).

The diversity of vertebrate fauna of the Cenozoic era has been found in the Bugti Hills (Balochistan) (Forster-Cooper, 1913; Metais *et al*., 2009). The specimens yielded from the Chitarwata formation mostly belong to Oligocene to early Miocene (Welcomme and Ginsburg, 1997; Marivaux *et al*., 2001, 2005, 2006; Antoine *et al*., 2003; Welcomme *et al*., 2001; Metais *et al*., 2003). The diversity of artiodactyla is very high (Metais *et al*., 2009) and includes many undescribed suid teeth. Despite their advanced wear and scarcity, the remains of Suidae are of significant attention, as the Paleogene ancient suids needs to be better studied (Ducrocq, 1998; Liu, 2003; Harris and Liu, 2007).

Conversely, certain genera have described very well on origin of their relatively more affluence as others have described in less because of the fixed figure of specimens such like *Propotamochoerus hysudricus*; consequently, each fresh fossil collection of said species is a novel addition of family Suidae in paleontological study. Fossil remnants for extinct genus Propotamochoerus of family Suidae have recognized from Upper Miocene to lower Pliocene of Asia as well as Europe (Lydekker, 1884; Pilgrim, 1926; Pearson, 1928; Van der Made and Han, 1994). The *Propotamochoerus hysudricus* species belong to Propotamochoerus genus existing in Siwalik ridges within range of age between 10Ma to 06 (Ma) (Aslam *et al*., 2019).

In this study, for the first time, we locatde and identified mandibular fragment of *Propotamochoerus hysudricus* from Sulaiman Range of Dharab locality near

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Sakhi Sarwar, Dera Ghazi khan, Pakistan having the age of Late Miocene- Early Pliocene from Litra formation to Chaudhwan formation.

MATERIALS AND METHODS

The specimen under study was gathered from Dharab village of Sulaiman Range near Sakhi Sarwar Tomb. This village is surrounded by freshwater sedimentary rocks deposits which have plenty of vertebrate fossil fauna. Sulaiman Range has complete sequence Late Miocene in the form of Litra Formation.

Specimen was collected from surface and some mandibular parts and p4 were detached from the major part of specimen, which were carefully picked and wrapped in cotton. Specimen was left mandibular fragment having m3-p4 dentition Collected specimen was brought to PC-CUVAS, Bahawalpur for further study. Specimen was cleaned and broken pieces were attached carefully with the help of elfy and glue.

Specimen was catalogued as PC-CUVAS 55/2023. The catalogue numerator represent the serial of collection of the year and denominator represent year of collection. For the necessary measurements in (mm), Digital as well as manual Vernier Caliper was used. Magnifying lens was also used to observe the uncertain and very minute characters for dental morphology. Teeth length of spacemen by anterior-posterior and width as lingual-buccal were measured (Khan *et al*., 2015). Taxonomy as well as terminology followed (Pickford, 1998).

Systematic Paleontology

Order- Artiodactyla
Sub order- Suiformes
Family-Suidae
Subfamily-Suinae
Genus *Propotamochoerus*
Species *Propotamochoerus hysudricus*

Generic diagnosis

Specimen under study PC-CUVAS-55/2023 (Fig. 1) is medium sized mandibular fragment. Specimen contain m3- p4, while anterior part having rest of teeth missing due to broken ramus. Specimen has well preserved dentine and having rugose enamel.

From distal to mesial of mandible is m^3 which is simple and well preserved containing four main cusps i.e., entoconid and protoconid as well as hypoconid and paraconid. Protoconid and hypoconid are elongated and more pointed than metaconid and entoconid. Cingulum in moderate quantity is found as mesial cingulum. Above the hypoconid minute ridge is buccal cingulum. Median accessory cusp is also pronounced. A portion of cingulum at termination side of median valley make the basal pillar. Posterior part of cingulum expends posteriorly to give rise to posterior accessory cusp and talonid. The color of enamel is dark brown and smooth in appearance.

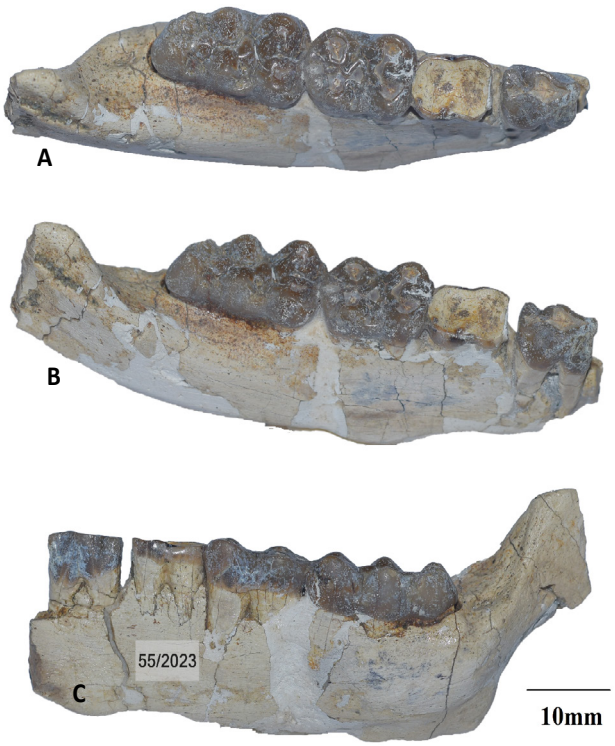

Fig. 1. *Propotamochoerus hysudricus* (PC-CUVAS 55/2023), left mandible fragment with m3-p4.
(A) occlusal view, (B) lingual view, (C) buccal view.

Protoconid is some larger than paraconid and is blunt inward. Well-developed valley behind paraconid form buccal cingulum. Metaconid cusp is some pointed than paraconid. Behind metaconid distal cingulum is seen clearly. In given specimen m1 is in front of 3 m^2. This tooth is not well preserved and crown is damaged. Outer ridges of protoconid and hypoconid are unclearly marked. Metaconid is diffused and cingulum not marked.

At the end of specimen is p4 which show clearly roots embedded in mandibular ramus, as ramus at the area of p4 is broken. Crown of p4 is well preserved. The central cusp is folded lingual side to form inner cusp. The anterior cingulum is moderately high. There some space exists between m1 and p4 due to damaged area of some part of m1. Dental measurements of studied teeth are listed below in the Table I.

Table I. The comparative dental measurements (in mm) of *Propotamochoerus hysudricus* from Sulaiman range.

Species/specimen	Nature/position	Length	Width	W/L ratio
Propotamochorous hysudricus				
CUVAS 55/23*	lm3	25.2	13.34	
	lm2	17.6	12.37	
	lm1	12.5	9.66	
	lp4	12.5	9.8	
PUPC 16/103	lm3	31.9	16.4	.51
	lm2	21	15.3	.72
PCGU-7/21	lm2	17.7	14	
	lm3	31.07	15.52	
PCGU-136/21	lm3	36.45	19.50	
PUPC 95/15	lm3	35.6	18	.50
	lm2	23.4	16	.68
	lm1	16.4	12.5	.76
PUPC 97/41	lm3	30	17.3	.57
	lm2	20.9	16.8	.80
	lm1	16.8	12.8	.76
	lp4	16.7	10.7	.64
PUPC 97/40	lm3	34.9	19.5	.55
	lm2	22	16	.72
	lm1	16.8	12.7	.75
	lp4	15.9	10	.62
PUPC16/86	lp4	18.3	12.3	.67
PUPC 16/85	lm3	29.4	15	.51
PUPC94/65	lp4	14.8	9.3	.62
	lm1	15.5	11.8	.76
	lm2	20	15.6	.78
PUPC 02/69	m3	27	14	.51
	m2	19.2	13.3	.69
	m1	13.7	10.7	.78
PUPC 16/188	m1	18.7	12.2	.65
PUPC 99/02	lp4	14.5	11	.75
PUPC 94/65	p4	15.6	12.6	.80
GSP 17	p4	15.5	11.6	.76
GSP 2503	p4	16.7	9.2	.55
GSP 10998	p4	14.4	11.3	.78
GSP12343	p4	16.6	11.4	.68
GSP 5823	p4	16	9.40	.58
GSP 12732	m1	17.6	13	.74
PUPC 07/32	m1	16	12	.75
GSP 10998	m1	16.6	12.5	.75
GSP 2807	m1	18.4	11.7	.63
GSP 6226	m1	17.5	12.4	.70
GSP 4773	m3	31	16	.51
GSP 5112	m3	30	15	.50
GSP 7384	m3	31.3	17	.54
PUPC 15/17	m3	28.9	15	.51
PUPC 15/18	m2	21.4	14.3	.66
PC-GCUF11/162	p4	12.7	14.4	1.13
PC-GCUF11/162	p4	12.3	14.5	1.16
PC-GCUF 12/24	p4	15.3	9.5	.62
B 742	p4	10.7	15.3	1.43
Tetraconodon magnus				
PUPC 13/37	lm3	29	55	.53
B 71	m3	32.5	50	1.54
Listriodon penta-potaminae				
PC-GCUF155/18	p4	12.25	7.2	
K 13/808	p4	15.30	12.30	
K 23/721	p4	16.10	12.50	
K 16/425	p4	18.90	14	
IVAU K 83	p4	17.2	11.50	
GSP 7017	m1	14.60	13	
HGSP 8427/3664	m1	18.6	13.4	
Listriodon guptai				
PAK 1386	p4	16.80	11.50	
PAK 1385	m1	19.20	13.30	
Conohyus sindiensis				
K41/836	m3	21.5	12.2	
PUPC 94/7	m3	24.5	14.0	
PUPC 18/10	lm3	23.58	13.57	
Conohyus indicus				
K16/482	m3	29.6	22	
MO3-101	m3	19.40	16.2	

Table continues on next column.....

*The studied specimen *Tetraconodon magnus, Listriodon pentapotaminae, Listriodon guptai, Conohyus sindiensis, C. indicus*

DISCUSSION

The suids of Siwalik are considered important collection and also important as they form noteworthy connection with other areas of world. Pilgrim (1926) was the first paleontologist who studied massive divergence in suids of Siwalik group. Pilgrim described that *Tetraconodon, Lophochoerus, Hipopopotamodon, Hippohyus* and *Sivahyus* are endemic genera. Pilgrim also described that certain common genus like *Listriodon, Sivachorus conohyus, Bunolistriodon* and *Propotamochoerus* as well as *Sus* in Siwalik, moved to Europe. Africa and other parts

of the world (Sarwar *et al*., 2016; Colbert, 1935b; Van der Made, 1996; Mathew, 1929; Pickford, 1988; Babar *et al*., 2021; Aslam *et al*., 2015).

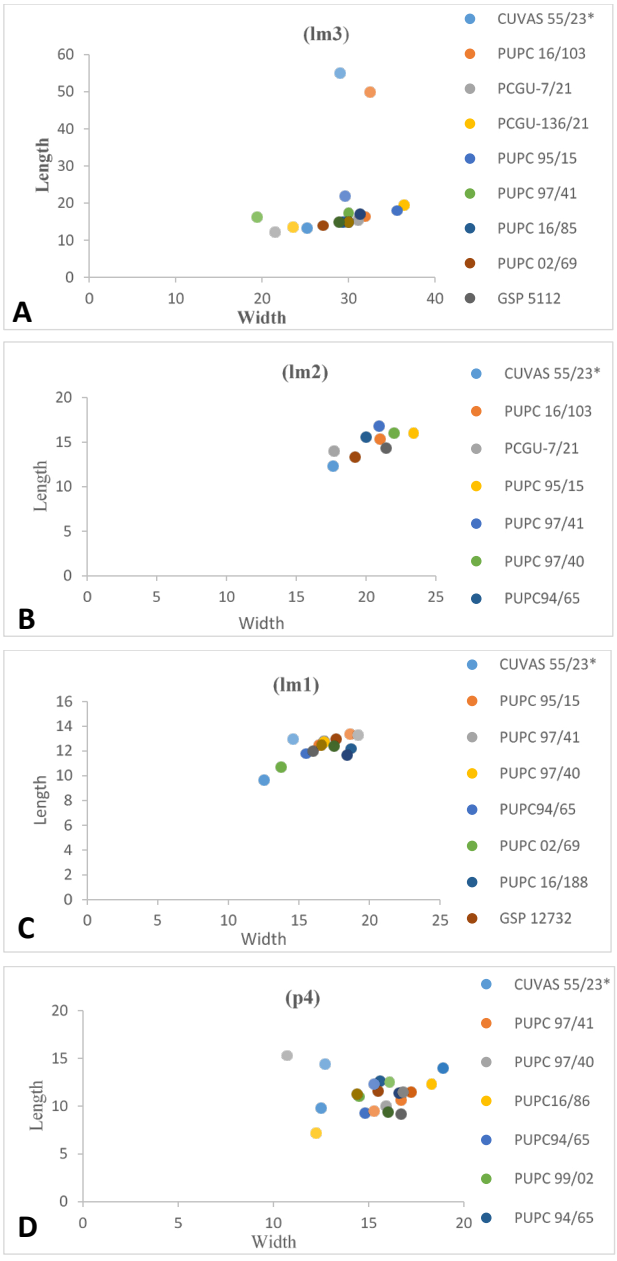

Fig. 2. Length width comparison of collected lm3 (A), lm2 (B), lm1 (C), p4 (D) with already identified specimens. *P. hysudicus, T. magnus, L. pentopotamnae, L. gupyai, C. sindensis, C. indicus.*

The common of Siwalik and Europe are *Listrodon, Bunolistrodon, Conohyus*, *Sus* and *Propotamochoerus* (Pilgrim, 1926; Pickford, 1988; Colbert, 1935; Van der Made, 1996). Suids of Africa evolved from primitive Siwalik *Sus* (Pickford, 1988). *Propotamchoerus* in Asia and Europe is well known. Specimen of different ages of genus *Hipopotamodon* was present from 10-7 million years ago. The range of *H. sivalense* and *P. hysudricus* is very closer and seemingly *Microstonyx.* Though it is the Late Miocene fossil species that disappeared through Pliocene (Pickford, 1988).

Studied specimen has been accumulated from Dharab area of Late Miocene to Early Pliocene locality of Litra and Chaudhwan formation of Sulaiman Range. As Bunodont dentition is evident and more than one accessory conids are found. Also, protoconid and hypoconid are elongated than paraconid and metaconid suggest specimen to include in the Suidae family. The genera of Late Miocene to Pliocene represent comparatively larger sized teeth. As specimen belong to same age, so suggested to belong Late Miocene-Early Pliocene of Sulaiman Range. The Siwalik suids along with other regions of world form assemblages.

All over the world, the species in genus Propotamochoerus are as *P. wui, P. provincialis, P. palaeochoerus, P. hyotheriodes, P. hysudricus* and MN11-13 form of Europe (Van der Made, 1996; Pickford, 1988). Among all species of genus *Propotamochoerus*, *P. provincialis* and *Propotamochoerus palaeochoerus* have rcognized from the Europe (Fortelius *et al*., 1996). According to Sarwar *et al*. (2016), *P. hysudricus* is originated from *Hyotherium* near about 11 million years ago. *P. hysudricus* is distinguished from *Hyotherium* by large size and shape of p4 and sagittal cusplets. Lower crowned molars along shallow furrows place it in *P. hysudricus*. As *Propotamochoerus hysudricus* is well recognized from Potwar Plateau in Pakistan and India (Pilgram, 1926; Colbert, 1935; Lydekker, 1884).

In Indo-Pak sub-continent, all over the world significant the faunal replacement (the change of diet) was identified; the adaptations of the mammals from the wooded area to an open habitat during the middle Miocene range in age (14.5 to 11.8 Ma) and it is very significant age regarding climatic, global vegetation as well as faunal modifications. The technical as well as mathematical data regarding dentition record are selected as the molars with high crown were curiously well-structured in the Cenozoic era that consistently reinforced in taxa having Hypsodont dentition (Eronen *et al*., 2012; Tapaltsyan *et al*., 2015). The specimens are also compared with the already published data to correlate the size of molars (Fig. 2).

CONCLUSION

Propotamochoerus hysudricus was discovered from Nagri and Dhok Pathan Formation (10.2 to 6.8) Ma in Late Miocene (Barry *et al*., 2002). The Sulaiman Range reveals

the most complete sequence of Litra Formation (Late Miocene) group and yield as diversified fossil collection. As Nagri and Dhok Pathan Formation of Siwalik group is similar in age with Litra and Chaudhawn Formation of Sulaiman Range. Similar community of both formations of Potwar Plateau diversified. The p3 of *Propotamochoerus hysudricus* is relatively narrow as well as oval in shape. Conversely, the p3 of the *P. hysudricus* of India is constantly shorter. For the first time *Propotamchoerus hysudricus* species of family suidae is reported from Dharab area of Sulaiman range near Sakhi Sarwar tomb.

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Generative AI and AI-assisted technology statement

The authors declare that they have not used generative AI or AI-assisted technologies in the writing or editing of this manuscript.

Statement of conflict of interest

The authors have declared no conflict of interest.

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