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Hair Cuticle Scale Patterns In Hanuman Langur (*Semnopithecus entellus*) And Grey Slender Loris (*Loris lydekkerianus*)

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ABSTRACT: Hair cuticle scale patterns have been studied in many mammals across the world for purpose of taxonomy, interspecies comparison, species identification etc. Here we present characteristics of cuticle scale patterns, medulla and pigmentation in dorsal guard hairs of Hanuman Langur (*Semnopithecus entellus*). Though studies have reported these characteristics in *S. entellus* earlier, this study presents comparison of cuticle scale patterns, medulla and pigments in both adult and infant *S. entellus* and adult *Loris tardigradus lydekkerianus*.

Keywords: Cuticle, hair, Langur, *Loris tardigradus lydekkerianus*, medulla, scales, *Semnopithecus entellus*

INTRODUCTION

Identification and characterization of organisms has been done on basis of many features including morphology. Hair morphological characteristics have been used for developing keys for identification of species for purpose of taxonomy, comparative studies and forensic studies (De Marinis *et al.*. 1993).

Though some studies on hair cuticle scale patterns and medulla characteristics have been done in primates in India (Alfred *et al.* 2009, Sarkar *et al.* 2011), there has been no study on comparison of hairs from new born infant and adult monkeys especially with reference to *Semnopithecus entellus*, commonly called as Hanuman Langur or Grey Langur (Cercopithecidae family) to the best of our understanding. The present study was undertaken with the aim to study and compare cuticle scale patterns, characteristics of medulla and pigmentation in dorsal guard hairs from adult and new born *S. entellus* and seek differences if any between these hairs. Further, the aim of the study was to compare these characteristics with *Loris tardigradus lydekkerianus* commonly called Grey Slender Loris (Loridae family) to identify any characteristic differences between hairs from two different families of class Mammalia.

MATERIAL AND METHOD

Sample Collection

Dorsal guard hairs were taken from between shoulder blades of adult *S. entellus* (SE5) from museum specimen kept at Department of Zoology, ML Sukhadia University, Udaipur (Raj.) India; three infants of *S. entellus* aged 10-12 days (SE1), 1-9 months (SE2), Infant (SE3) and a Still born (SE4) respectively and adult *L. tardigradus lydekkerianus* from specimens kept in Prof. L. S. Rajpurohit's laboratory at Department of Zoology, JN Vyas University, Jodhpur (Raj.), India. These hair samples were collected in the year 2012 and processed for analysis between January to March 2013.

Cuticle Scales

For light microscopic examination, hairs were first washed with xylene for few minutes to remove dirt. Hair cuticle scale patterns and scale margins were studied by casting clean hairs on the thin film of polyvinyl chloride (PVC) or polyvinyl acetate (PVA) on the glass slide (Brunner and Coman 1974). After some time when PVC or PVA dried, the hairs were pulled out from the slide and the casts in the mid shaft of hairs were observed under the light microscopes as per methods of Brunner and Coman (1974).

Medulla and Pigment

For study of medulla, the cleaned hairs were bleached with solution of hydrogen peroxide (70%) and ammonia (30%). The degree of bleaching was modified by changing the length of time in the solution (De Marinis *et al.* 1993). Hairs were then placed on a slide and mounted with an appropriate reagent like DPX and observed under the light microscope. Hair medulla and pigmentations were also studied by following the methods as described in Goyal and Sahajpal (2009) where hair samples without bleaching were mounted in DPX and cover-slip especially in case of *L. lydekkerianus* where medulla was visible without treatment.

Scale and Medulla Identification

Hair cuticle scale patterns, scale margins, scale distance and medulla types were identified based on keys according to Hausman (1920), Burnner and Coman (1974), Debelica and Thies (2009), Goyal and Sahajpal (2009) and keys provided by Crutcher (1978) and FurSkinLink (http://www.furskin.cz/identification.htm).

OBSERVATION AND DISCUSSION

Hairs have characteristics which provide diagnostic features that may be useful for taxonomy (De Marinis *et al.*. 1993). However, in some cases, especially regarding light microscopy examination, these features may not be helpful in distinguishing closely related species for example in case of human and other apes no differences are discernible according to Amaral (2008).

The present study on adult *S. entellus* (Fig. 1e and f) corroborates with earlier study where cuticle scales are reported as imbricate (Areida *et al.* 2006, Sarkar *et al.* 2011), crenate with irregular wave pattern and distant (Sarkar *et al.* 2011). Hair cuticle scale patterns in *L. tardigradus lydekkerianus* are imbricate and elongate (horizontally) (Fig.1g) and match the descriptions of *Glis glis glis* (Hausman 1920) and as seen in Scanning Electron Microscope (SEM) images (Alfred *et al.* 2009). However, the scales margins in *L. tardigradus lydekkerianus* are not very smooth (Fig.1g) and appear more or less like even tele-like scales (FurSkinLink). Further, the present study also shows differences with scale patterns observed in *L. tardigradus lydekkerianus* with other studies where they are described as imbricate and mosaic in *Loris tardigradus tardigradus*, *Loris tardigradus grandis* and *Loris tardigradus nordicus* (Amerasinghe 1983).

The present study in all three infants of *S. entellus* shows that the distance between scales is larger compared to the adult (Figs. 1a-d). Further, there are some other differences between young ones of *S. entellus* where SE2 and SE3 cuticle sale margins are not smooth. Scales are tall in SE3 hairs and mid margins of scales is raised and distance is narrow, thus appearing to be chevron like. Scale rows are regular to irregular in all except appear broken at some places in SE2 and adult monkey.

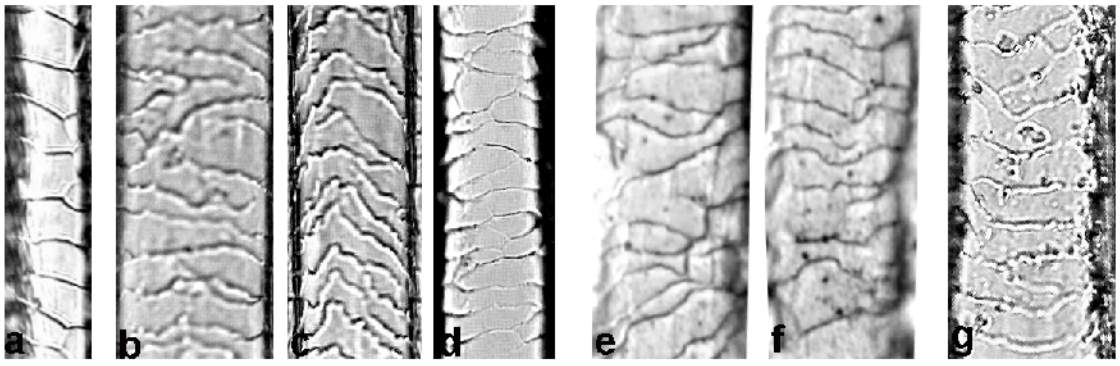

Fig.-1: Scale patterns in *S. entellus* (SE) and *L. tardigradus* (Lo). SE-1= 10-12 days, SE-2= 1-9 months, SE3= Infant, SE4= Still born, SE5a & b= Adult. Mag. SE5 10x40 all others 10x50

S. entellus scale margins are not significantly different from Chimpanzee (Inagaki and Tsukahara 1993), orangutan *Pongo pygmaeus* (Partin *et al.* 2004a) and Gorilla (*Gorilla gorilla gorilla*) (Western Lowland Gorilla) except for small distance between scales and rippled edges in (Partin *et al.* 2004b). Scale patterns are described as imbricate and crenate in *Naosalis larvatus* (Proboscis Monkey) and *Ateles geofferoi* (Spider Monkey) (Hausman 1920); SEM studies in other primate hairs like that of *Macaca assamensis assamensis*, *Macaca faciculars aurea* (De 1993), *Macaca mulatta* (De 1993, Alfred *et al.* 2009), *M. radiate*, *Trachypithecus phyraii*, *T. johnii*, *T. geei* and *Bunopithecus hoolock* (Alfred *et al.* 2009). However, scale patterns (in some of these primates) described on basis of SEM are different from light microscopy based studies in *T. pileatus*, *T. geei*, *T. johnii* and *T. phayrei* where it is regular wave with smooth and distant margins except in *T. johnii* where it is crenate (Sarkar *et al.* 2011). Further, the present study also shows differences with scale patterns described as imbricate and mosaic in *Macaca sinica*, *Presbytis entellus thersites* and *Presbytis senex* (Amerasinghe 1983). Scale patterns of *Chrysothrix sciurea* (Squirrel Monkey) and *Simia satyrus* (Orang) are imbricate and flattened (Hausman 1920) and thus show some differences with those of *S. entellus* hair scales.

Apparently *S. entellus* and *L. tardigradus lydekkerianus* hair cuticle scales do not show an angle to the axis of hair and possibly this feature can be used for deciphering *S. entellus* and *L. tardigradus lydekkerianus* hairs with other monkey/primate hairs. For example, Douc langurs *Pygathrix cinerea*, *P. nemaeus* and *P. nigripes* and the Tonkin snub nosed monkey (*Rhinopithecus acunculus*) in Vietnam show differences only in scale height were scales of *R. acunculus* are smaller than the *Pygathrix* species. The cuticles scales are irregular, vary in different regions of hair but have smooth to crenate edges. In *P. nemaeus*, the scales are long and form a flat mosaic and are at a right angle to the axis of the hair. In *P. cinerea* scales are usually rectangular to the long axis of the hair but at the tip the strong bent in scales forms chevron pattern. In *P. nigripes* the only marked differences is chevron pattern in the mid hair at times which is not seen at the base of tip of hairs. In *Rhinopithecus avunculus* the scales are at right angle to the axis of hair, are smooth to slightly crenate at the base but in mid hair are usually crenate at the tip (Stefen and Szokoli 2010). There are few interspecies differences in hair characteristics of members from Galagoninae family (Anderson 2001). From the images provided in the paper, it appears that scales have smooth margins.

Like previous study on *S. entellus* (Sarkar *et al.* 2011), chimpanzee (Inagaki and Tsukahara 1993) and Gorilla (*Gorilla gorilla gorilla*) (Western Lowland Gorilla) (Partin *et al.* 2004b), both adult and infant *S. entellus* have simple medulla (Figs. 2a and c) except that in gorilla medulla is wide (Partin *et al.* 2004b). However, the present study shows differences in medulla and pigmentation in hair samples obtained from different ages of *S. entellus*.

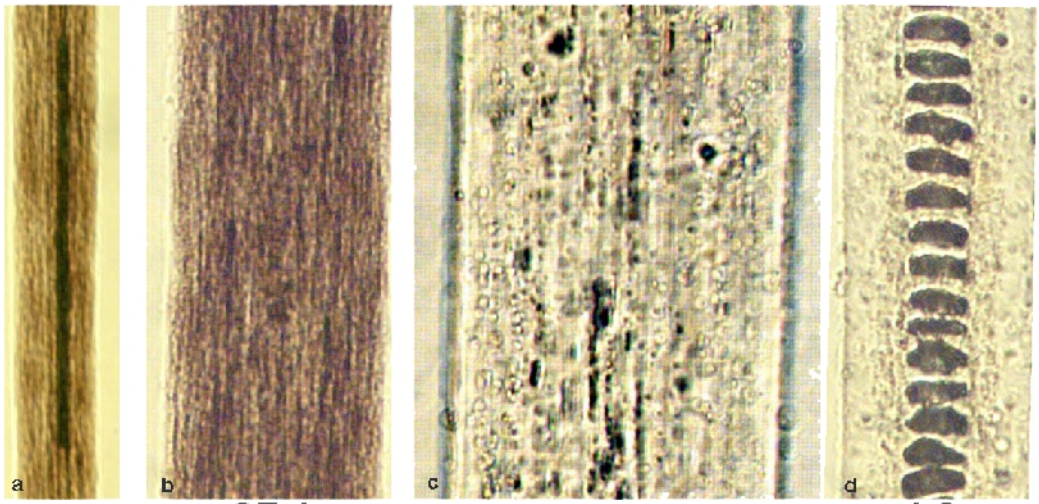

Fig.-2: Medulla and pigment characteristics in *S. entellus* (SE) and *L. tardigradus* (LO) hairs. a) SE-1= 10-12 days, b) SE-4= Still born, c) SE-5= Adult, d) LO= *L. tardigradus* Mag- 10x50

In the still born, medulla is not visible and the hair is heavily pigmented (dark brown) (SE4, Fig. 2b) compared to discontinuous medulla in infant (Fig. 2a) with hair having brown pigment which is lighter than still born and fragmental medulla in adult (Fig. 2c) where there is scattered light grey pigment visible in the hair. However, medulla is different from *T. pileatus* where it is uniserial ladder, interrupted medulla in *T. geei*, *T. johnii* and *T. phayrei* (Sarkar *et al.* 2011) and orangutan *Pongo pygmaeus* but narrow medulla (Partin *et al.* 2004a).

The present study shows similarity of *L. tardigradus lydekkerianus* medulla with *T. pileatus* (Sarkar *et al.* 2011) as it is interrupted uniserial ladder like (Fig. 2d), and ladder like in hairs of subfamily Cercopithecinae [*Mandrillus sphinx*, *M. leucophaeus*, *Cercocebus torquatus* (not regular) and *C. a. lunulatus*] (Inagaki and Yamashita 1994). Light grey pigmentation is seen in *L. tardigradus* hair (Fig. 2d), thus, *L. tardigradus lydekkerianus* shows differences with medulla of *S. entellus* but similarity in pigmenation.

Medulla of *S. entellus* is also different from Japanese monkey *Macaca fuscata fuscata* as it is not continuous and some hairs (especially in thin hairs) may not have medulla (Inagaki 1986). Dense and discontinuous medulla is reported in lesser ape *Cercopithecus aethiops* and *Pongo pygmaeus* has intermediate and fragmental medulla. Human hairs have intermediate and fragmental yet dense medulla (Clement *et al.* 1981).

CONCLUSION

The present study shows that hair cuticle scale patterns are not significantly different in different species of apes including young ones of *S. entellus* except differences in distance between scales and scale margins. However, pigmentation and medulla are different in different age groups. Scale patterns are different between the two families of primates i.e. Lorisidae and Cercopithecidae where scales are imbricate and elongate in Lorisidae compared to regular and or irregular wave pattern in Cercopithecidae. However, the most distinguishing feature is medulla which is ladder like in Lorisidae but simple and discontinuous or fragmental in Cercopithecidae. Thus a combination of scale patterns, pigmentation and medulla are necessary for identification of hairs.

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