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Full Length Research Paper

Epidermal sense organs of the Gekkonid *Tropicolotes tripolitanus* Peters 1880

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Seven Juvenile stages (I,II,III,IV,V,VI and vii) of the Gekkonid *Tropicolotes tripolitanus*, Peter, (1880) were investigated. Scannin electron microscopic examination of the dorsal skin of head and trunk region exhibited the presence of lenticular epidermal sense organs with characteristic emerging hair let structures of different forms according to the studied developmental stages. At SEM, stage I and II exhibited similar epidermal scale taking triangular structures with lenticular sensory organ having only 1 or 2 sensory filaments. At stage III, 2 types of epidermal scales were detected larger (old) and small (regenerated) with marked increase of sensory organs especially in trunk region. During the proceeding stages, the regenerated scales become more numerous and spread in-between the degenerated old ones.

Key words: Gekkonid Tropicolotes tripolitanus,Epidermal sense organs

INTRODUCTION

Integument sense organs were firstly described for reptiles by Leydig (1868) in the lizards genera *Lacerta* and *Angus* and in the snake genus *Coronella* and the small depressions he found in the surface of their scales were considered as “organs of the 6th sense” Leydig and compared them with the taste buds of fishes and amphibian. Scortecci (1941) examined in details the receptors of Agamids and Iguanids species. Crotaline and Boid snakes possessed infrared imaging receptors called pit organs, which work along with their visual and other sensory system to enable them to detect, locate and apprehend prey (Bullock and Diecke, 1956; Barrett et al., 1970). Little is known about the presence and structural pattern of these thermoregulatory organs in lizards. The receptors possessing hair-like structure were described by many authors under different names (hair-like structures, setae-bearing organs, receptors with bristles and so on). Landmann (1975) described 6 different types of skin receptors; one with bristles and others without. de Haan (2003) reported the presence of small sense-organ-like pits on the top of the head of several psammophine snake species including *Dromophis lineatus*, *Malpolon monspessulanus, several Psammophis species* and *Rhamphiophis rubropunctatus*.

The present study deals with illustrating the number, distribution and characteristic structural pattern of epidermal sense organs during juvenile growth of the Gekkonid *Tropicolotes tripolitanus* Peters 1880.

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MATERIALS AND METHODS

28 juvenile individuals of *T. tripolitanus*, Peter, (1880) (Subclass, Diapsida Order, Squamata Suborder, Lacertilia Family, Gekkonidae Genus, *Tropicolotes* Species, *tripolitanus* (Peter, 1880)) were collected from Abou- Rawash desert, Giza Governorate, Egypt. The specimens were categorized into 7 stages according to the variations of hind limb length, width of head region and length measurements of trunk and tail region as presented in Table 1 and Figure (1).

For SEM investigations, pieces of whole skin were excised from both the dorsal surfaces of the head and trunk region of the developmental stages of *T. tripolitanus*. Care was taken when the skin was cut to avoid excision of scales. The specimens were immediately fixed in 2.5% phosphate buffered glutaraldhyde pH 7.4 for 24 h, followed by washing thoroughly in phosphate buffer (pH 7.4) and dehydrated in ascending grades of ethyl alcohol. The specimens were critically point dried through CO_2 in a polaron drying apparatus. Finally, the specimens were coated with gold in a sputter coater and examined in the scanning electron microscope, Alexandria Univ-Lab. and photographs were taken. The numbers of old (Large) and regenerated (small) scales were counted in different regions of both the dorsal surface head and neck region at magnification X 100. The total numbers of epidermal sensory organs/scale were recorded for both large and small scales. The distribution of the sensory organs in both the scales of the dorsal surface of the head and trunk region were taken in consideration.

Table 1. Length measurements (mm) of different parts of the used stages of *T. tripolitanus.*

	Stage I	Stage II	Stage III	Stage IV	Stage V	stage VI	Stage VII
Whole Length	5.4	6.6	8.5	9.1	10.1	10.4	10.7
Head Length	1.1	1.2	1.4	1.6	1.7	1.9	2.1
Width of Head	0.6	0.7	1.0	1.2	1.3	1.6	1.7
Neck Length	0.6	0.7	1.0	1.2	1.3	1.6	1.7
Trunk Length	2.1	2.6	4.0	4.3	4.6	4.6	4.9
Tail Length	3.0	4.0	4.5	4.5	5.8	5.8	5.8
Length of Hind Limb	0.9	1.1	1.4	1.6	1.8	1.9	2.2

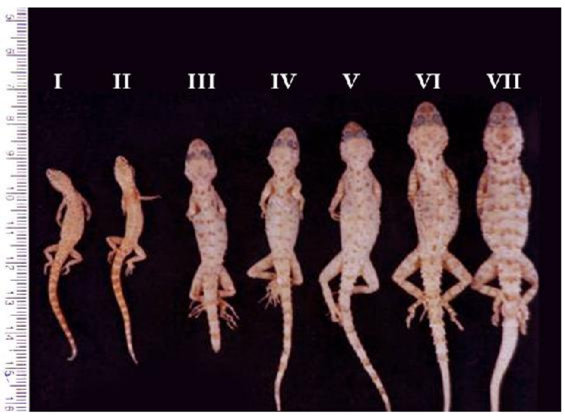

Figure 1. Dorsal vie photomacrographs of growing stages of juvenile *T. tripolitanus*.

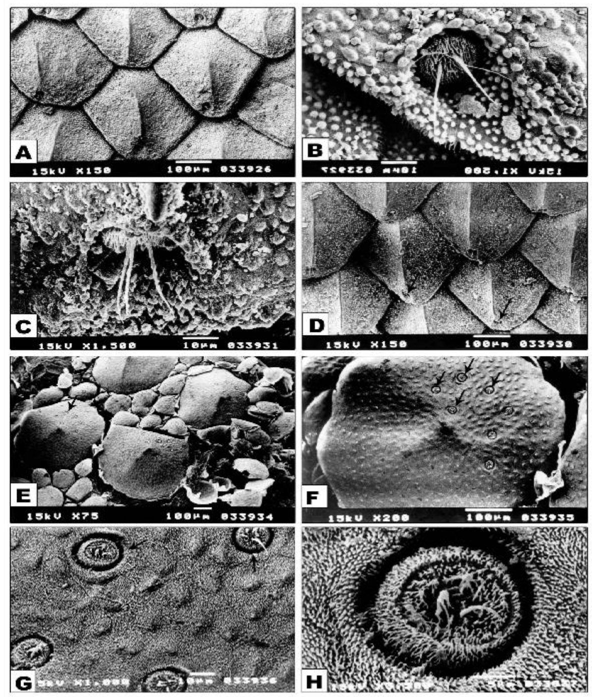

Figure 2A - H. Scanning electron micrographs of *T. tripolitanus* showing overlapping scales. A and B. Stage I. epidermal sense organ with 2 hairlet structure. C and D. Stage II epidermal sense organs with three hairlet structure. E - H. Stage III. E. Old (large) and regenerated (small) scale. G and H. Epidermal sense organs with more than 4 hairlet filaments. Abbreviations ; arrows : epidermal sensory organ.

RESULTS

Stage 1 exhibited triangular overlapping scales with median convex and conical-shaped free end. The width appeared semi-equal to the length of the scale in the head region. However in the trunk region, the length of the scale exceeded it width. The scales surfaces showed regular distribution of spinulate-hillock structures. The oberhautchen appeared more distinguished in the head region. Both the head and trunk scales showed only one epidermal sense organ located at the distal terminal apex of the scale. The epidermal sense organ appeared as round deep depression, lens-like base with an emergent, hair-like bristle above the scale surface. The epidermis beneath the pit was slightly depressed. The edge of the sense organs sharply delineated and the rim is concave on the inner surface. Each sense organ showed attachment of 1 or 2 hairlet filaments. At the caudal free end of the scale, a lenticular sense organ appeared in the form of large round depression housing with elevated deep layers. Each of the scale showed only one lenticular sense organ. The epidermal sense organ possessed 2 adherent sensory filaments and immature epidermal layers and encircled by a deep depression (Figure 2 A and B).

In stage II, the morphological structures of the scales appeared closely similar. In trunk region, the oberhautchen layer of the outer epidermal generation possessed more developed conical-shaped immature spinules comparing with that of the head region. The epidermal lenticular sense organ is still detected at the caudal end of the scale. Each lenticular sense organ showed 2 adherent elongated sensory hairlet filaments and ensheathed by narrowing clear lacunar layer. The lenticular sense organs appeared more differentiated in the head region (Figure 2 C-D).

In stage III, 2 types of scales are recognized, large and

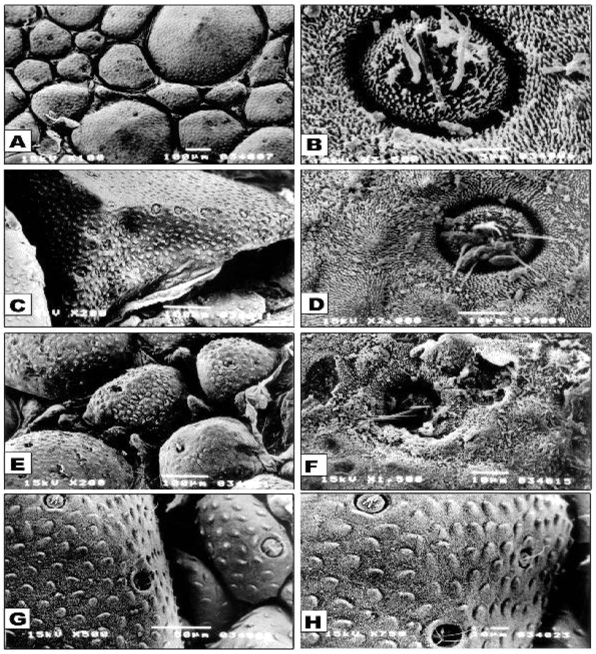

Figure3A-H. Scanning electron micrographs of *T. tripolitanus* showing overlapping scales. A and B. Stage IV. epidermal sense organ with more than hairlet structure. C and D. Stage V epidermal sense organ with 6 hairlet structure. E and F. Stage VI showing both Old (large) and regenerated (small) scale, epidermal sense organ begin to retracted. G and H. Stage VII showing retracted epidermal sense organ. (small) scale. Figures G and H. Stage VII showing retracted epidermal sense organs.

small ones. Large scale (old ones) took either a triangular-shaped-structure with convex medial region or contracted and lacked normal structural pattern. Each of the old scales showed partial ruptured and degenerated peripheral epidermal cell layers underneath the scale, leaving a zone of weakness at the perimeter of this kind of scale. These fractures between the loosening part of the epidermis and inner belting epidermal cell layers exhibited the sign of shedding. The lenticular sense organs become distributed either near the center or at the caudal end of the scale. It is overlained by a thin tissue fragment and possessed 3 elongated filament structures. 7 lenticular sense organs are observed per each large scale. The other type of scale being small (newly formed) and fill the wide area between the large scales. The small scale appeared rounded in shape with one lenticular sensory organ/each scale and localized merely near the central zone. In trunk region, there is a marked increase of newly regenerated small scales comparing with the large ones (old). The old scales contracted and acquired a circular-shaped structure with convex central region. The epidermal layers surrounding the peripheral edges of the old scale ruptured and forming a lacunar space between the outer loosening part and the rest of the cell layers of the epidermis. The large scale possessed 6 - 8

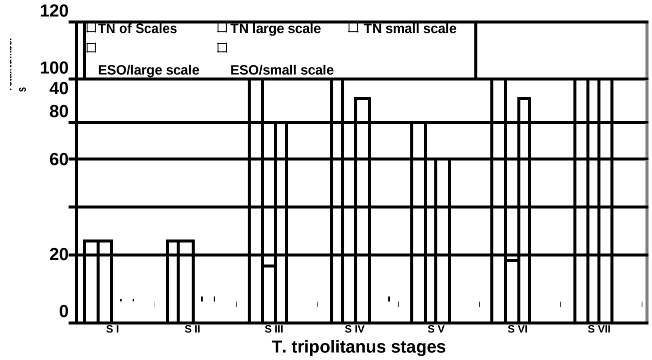

Figure 4. epidermal sense organ (ESO) distribution in large and small scales of head region of developing stages.

epidermal sensory organs, which appeared to be distributed near the central region of the scales. After removing the scales, the epidermal sensory organs appeared to be one of the main structural constituents of the epidermal layers of the inner generation (Figure 2 E-H).

In stage IV, the skin surface revealed the presence of numerous generated small scales with prominent more than one lenticular sense organ in both the head and trunk region. Each scale acquired a semi-circular pattern with concave central region. The epidermal cells layers inbetween the edges of the scales appeared fragmented, loose and not compacted with the other epidermal layers. Each ventricular sense organ exhibited 4 adherent hairlet structures. The oberhautchen layer covering the surface of the scale showed a peculiar keratinized micro ornamentation. The inner generation of the trunk skin showed network ridges corresponding to oberhautchen surface. The lenticular sense organs are distributed in the inner epidermal generations and form main structural components of the epidermal layers (Figure 3 A and B).

Stage V exhibited marked contraction of head scales. The superficial epidermal layers encircled the scales become ruptured and folded. The epidermal sense organs arranged in the midline of the scale. Each sensory organ exhibited the presence of 6 sensory hairlet structures. In the dorsal surface of the trunk region, the ruptured superficial epidermal layer loosed the intimate contact of the scale with the epidermis. Numerous epidermal sensory organs are arranged on the triangular structure at the distal end of the scale. The epidermal sensory organs lacked its normal ordinary structures. At the deep furrow of the caudal end of the large scale, there is a dense collection of oval- shaped bacterial cells attached to the surface of the scale (Figure 3 C and D).

In stage VI, there is a marked increase of regenerating small scales. At the dorsal surface of the head, the scales possessed spotty areas of fragmentation and degeneration associated with considerable retracting of sensory tactile hair of the epidermal sensory organs. The epidermal layers underneath the edges of the scale

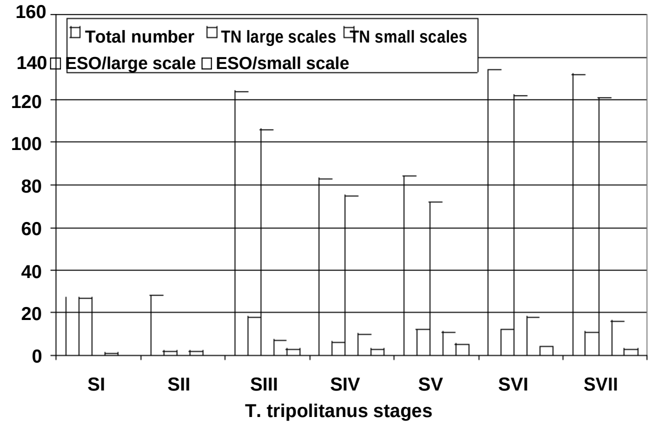

Figure 4. epidermal sense organ (ESO) distribution in large and small scales of trunk region of developing stages.

become loose and ruptured (Plate 8, Figure 3C). In the dorsal surface trunk region, the regenerating small scales are numerically increased. Deterioration of the scale surface and epidermal layers underneath it become more prominent. Many of the epidermal sensory organ exhibited withdrawal of their sensory tactile hair (Figure 3 E and F).

At stage VII, the scale surface showed marked compression with loosely attached peripheral epidermal layers underneath the scales. There are numerical increases of regenerating scales distributed inbetween the old ones (Figure 3 G and H).

Morphometric observations

Figure 4 and 5 illustrate the distribution of epidermal sensory organs in both large (old) and small (new regenerate) scale of both dorsal head and trunk regions of developing stages of *T. tripolitanus* stages. The total numbers of scales are markedly increased in trunk region more than that on head with the advancement of growth. The large scales (old) are predominated only in stage I and stage II A least number of epidermal sensory organ are detected per each in early stages I and II and their number increased gradually with the advancement of growth. At stage III and the subsequent growing stages the total numbers of scales are markedly increased. The majority of them are new regenerated small scales comparing with the least number of the old (large) scales. There are numerical increases of epidermal sensory organ in large scales comparing with the small regenerating ones.

DISCUSSION

The present study showed that SEM observations of dorsal surface of head and trunk regions the used lizard *T. tripolitanus* stages I and II (hind limb exhibited a similar type of scales having a triangular-shaped structure. The surface of the scale showed regular pattern of spinulate-hillock structures. However, the beginning of the growing stage III and the subsequent stages IV, V, VI and VII exhibited the presence of regenerated scales (small scales) comparing with the old (large) ones.

The present findings confirmed the previous studies carried out by Maderson (1965), Liu and Maneely (1969), Dhouailly and Maderson (1984) and Alibardi (1996, 1998) on different species of lizard skin. The regenerative power of the scales made their first appearance at stage III and being more prominent in the dorsal surface trunk region than that of the head region. With the advancement of developmental stages IV, V, VI and VII, the capacity of regeneration proceeded and manifested by numerical increase.

The present results revealed that at earlier developmental stages I and II, each head and trunk scales exhibited only one epidermal sense organ found mainly the terminal distal end of the scale. The epidermal sense organ appeared in the form of lenticular pit on the skin scale surface. At the base of the organ, a delicate bristle-like structure originated and projected forward to the scale surface. The epidermis beneath it was slightly depressed and the edge is sharply delineated. The surrounding surface showed a micro-ornamentation of ridges. At these stages, each epidermal sense organ exhibited the presence of one or two sensory tactile hairs. In the proceeding developmental stages III, IV, V, VI, VII, there are marked regeneration of small scales arranged randomly inbetween the old ones. At first the regenerated small scales lacked the presence of sense organs and then exhibited 1 or 2 epidermal sense organs in other generations of small scales. At early stages, the epidermal sense organs arranged nearly the central region of the small scales. With the advancement of growth, there are numerical increases of epidermal sense organs reaching to 18/each scale especially in trunk scales. A single sense organ can be supplied with 1, 2, 3 or 6 bristles (hairlet structure) according to the developmental stage of the studied species.

Similar findings were reported by many authors in another Gekkonid species. In the Australlian geckos *Phyllurus platurius*, Hiller (1971) had shown an unusual structure for the bristle, which was covered with smaller hair over its last third. In *Tarentola neglecta*, a receptor with numerous short parallel setae had been reported (Loger, 1984). According to Williams (1988) Oplurus fierinensis is the only species of oplurine in which the integument has been shown to have not a hair but a multi-hair skin sense organ.

In addition, the emergent of more than sensory hairlet structure with the advancement of growth facilitated in performing mechanical and sensory functions to accommodate with their habitat.

Similar findings were reported in *Amphibolurus barbatus* (Maclean , 1980) and Iguanian lizards (Ananieva et al. (1991). Maclean (1980) reported that these sense organs exhibit mechanoreceptors. Ananieva et al. (1991)

mentioned that it serves several functions as mechano and thermoreceptors and possibly sensitivity to humidity. Mechanoreceptor, function. de Haan (2003). Jackson and Doetsch (1976), Von Düring (1973) and Von Düring et al. (1979) observed more complex touch corpuscles on the skin surface of the head of snakes as small elevations.

de Haan (2003) studied *D. lineatus*, *M. monspessulanus,* several *Psammophis* species and *R. rubropunctatus* and observed small cephalic structures, generally called pits situated on diverse upper head shields and may be appear to serve as final joints between old and new skin, enabling correct shedding at an opportune moment.

It is clear that from the previous illustration that the scale morphogenesis and structural and pattern of arrangement of sense organs with the advancement of developmental stages are of great interest for the Gekkonid *T. tripolitanus* Peters 1880. These structures play a great role for accommodating their living in its environmental habitat.

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