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Zoological Research

Comparison between the Medullary Indexes of Hairs from *Apodemus orestes* and *A . draco* , with Discussion about the Taxonomic Status of *A . orestes*

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Abstract: The taxonomic status of long-tailed field mouse (*Apodemus orestes*) is still uncertain up to now. Some scholars regarded it as a subspecies or a synonym of dragon field mouse (*A . draco*), while other scholars considered it a valid species. In the study, five specimens of adult long-tailed field mouse, dragon field mouse and Chevrier's field mouse (*A . chevrieri*) (as a contrast) were chosen respectively. After treated, with the eyepiece micrometer in the inverted microscope, we made measurements of the widths of hairs and medullas and then calculated the medullary indexes of straight guard hairs from around the mouth, head, back, abdomen and forelimb of each species. The results indicate that, viewing at each of the five parts and the mixture of the five parts, there are no significant differences between *A . orestes* and *A . draco*, Significant differences can be found between *A . orestes* & *A . chevrieri* and *A . draco* & *A . chevrieri* though. The standpoint that *A . orestes* was listed as a valid species is not supported by this study.

Key words: *Apodemus orestes*; *Apodemus draco*; Medullary index of hair; Taxonomic status

长尾姬鼠、中华姬鼠毛髓质指数比较及长尾姬鼠分类地位的探讨

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摘要: 关于长尾姬鼠 (*Apodemus orestes*) 的分类地位, 一直没有确定。有的认为它是中华姬鼠 (*A . draco*) 的一个亚种, 而有的认为是一个独立的种。分别从成体长尾姬鼠、中华姬鼠和高山姬鼠 (*A . chevrieri*) (对照) 各 5 只的胡须、头部、背部、腹部、前肢取毛样, 清洗和处理后, 在倒置显微镜下观察, 用目镜测微尺分别测量和计算出其 5 个部位毛发的毛髓质指数。结果表明: 长尾姬鼠与中华姬鼠 5 个部位及混合毛发的毛髓质指数无显著差异; 二者 5 个部位及混合毛发的毛髓质指数与高山姬鼠均有显著差异。不支持长尾姬鼠作为一个独立种的观点。

关键词: 长尾姬鼠; 中华姬鼠; 毛髓质指数; 分类地位
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Apodemus orestes is morphologically very similar to *A . draco*, therefore its taxonomic status is mostly related to that of *A . draco*. Thomas (1911) classified *A . orestes* as a subspecies of Japan field mouse

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(*A. speciosus*) and named it as *A. speciosus orestes*; Allen (1938) found *A. speciosus orestes* to be a subspecies of Wood mouse (*A. sylvaticus*), he named it as *A. sylvaticus orestes*; Ellerman & Morrison-Scott (1951) supported the standpoint of Allen (1938). Some authors considered *A. orestes* a subspecies or a synonymy of *A. draco* (Corbet, 1978; Wilson & Reeder, 1993; Musser et al, 1996; Xia, 1984; Hu & Wang, 1984; Zhang et al, 1997; Zhang, 1999; Wang & Hu, 1999; Wang et al, 2001; Honacki et al, 1982), and some other zoologists claimed *A. orestes* to be a separated species (Corbet & Hill, 1992; Nowak, 1999; Sheng et al, 1999; Wang, 2003; Jiang & Wang, 2000; Liu et al, 2000; Yang et al, 2002). The debate about the taxonomic status of *A. orestes* is still going on.

Microscopic morphological characteristics of mammalian hairs provide taxonomic information (Jin & Zhang, 2003; Zhang & Xu, 2003). Based on this, we compared the medullary indexes of hairs from *A. orestes* and *A. draco* and then discussed about the taxonomic status of *A. orestes*.

1 Materials and Methods

1.1 Materials

The specimens of *A. orestes*, *A. draco* and *A. chevrieri* were chosen from the Specimen Museum of Institute of Rare Animals and Plants in China West Normal University, as well as all adults, mostly were males. *A. chevrieri* was used in contrast to *A. orestes* and *A. draco* (*A. orestes*: 3 ♂♂ : 2 ♀♀, *A. draco*: 4 ♂♂ : 1 ♀, *A. chevrieri*: 4 ♂♂ : 1 ♀). The collecting places were Mt. Omei (Sichuan Province, China) where is the type locality of *A. orestes*. In order to avoid errors caused by the changes of hairs' medullas in different seasons or at different altitudes with a large difference, the collecting time was limited from the end of September to the beginning of October, and the altitudes of the collecting places ranged from 2 430 m to 2 750 m. 50 straight guard hairs were picked from each of the five parts—around the mouth, head, back, abdomen and forelimb—of each of the three species.

1.2 Methods

1.2.1 Preparations and observations of hairs' medullas Hairs from each of the five parts were separately placed in small clear number-marked culture dishes, and then were treated and observed by the following process: they were put into soap water for cleaning for 2 days, then dried naturally in the air, degreased in mixed solution of 95% alcohol and ether (1∶1, v/v) for 20 minutes, cleaned in anhydrous alcohol for 10 minutes, made transparent in xylene for 15 minutes, placed on slides, dried naturally in the air, covered with other slides of the same size and clipped with swallow-tailed clips and observed in inverted microscope (XSZ-D_2, Chongqing Optical and Electrical Instrument Co. Ltd., Chongqing, China). Finally, photos (Fig.1) were taken with a camera (MCK1000, Chongqing Mingca Photo-electric Cell Factory, Chongqing, China).

1.2.2 Measurements of the widths of hairs and medullas and calculating method for medullary indexes

The hairs that didn't suffer damage during the course of the treatment were selected. By choosing measuring points around the middle part of every hair and using the eyepiece micrometer (the accuracy is 4 μm.) in the inverted microscope to measure the widths of

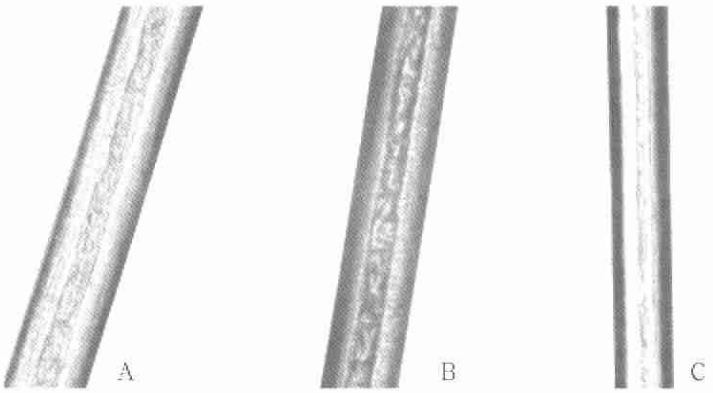

Fig.1 Sample photos for hairs and medullas (in the middle parts of the hairs) of whiskers from *A. orestes* (A), *A. draco* (B) and *A. chevrieri* (C) (Amplified 250)

medullas and hairs, medullary indexes were calculated according to the formula: Medullary index = the width of medulla/the whole width of the hair. Only one medullary index was measured from each hair, so the number of selected hairs from each part of each species was exactly the number of medullary indexes (n) showed in Table 1.

1.2.3 Treatments for data of medullary indexes The statistical analyses were performed with software SPSS 10.0 For Windows. Firstly, the basic description was given. Secondly, based on the tests of normal distribution and the tests of homogeneity of variances, the one-way ANOVA was used to analyze whether there were significant differences among the three species.

2 Results and Analyses

Comparing from the same part and the mixed, the results showed that there were no significant differences between *A. orestes* and *A. draco*; there were significant differences between *A. draco* and *A. chevrieri*; Except for the back, there were significant differences between *A. orestes* and *A. chevrieri* (Table 1).

3 Discussion

The statistical result for the back of *A. orestes* and *A. chevrieri* showed that they were not markedly different. Will this affect revealing a significant difference in *A. orestes* and *A. chevrieri*? Moreover, the results for the other four parts and the mixed firmly indicated significant difference in *A. orestes* and *A. chevrieri*.

Analyzing the controversial problem viewing at the dialectical relationship of entirety and parts, we can say that the results of interspecific comparisons include these of comparisons between the same parts.

In a word, as discussed above, from the angle of medullary indexes of hairs, *A. orestes* and *A. draco* have no significant difference and they both differentiate considerately from *A. chevrieri*.

Table 1 Medullary indexes of hairs from each of the five parts and the mixture of the five parts of *A. orestes*, *A. draco* and *A. chevrieri*

Parts	Species	n	Range	Mean ± SD	F
Whisker	*A. orestes*	10	0.2400 ~ 0.3846	0.2885 ± 0.0468^{a}	58.290**
	A. draco	12	0.2593 ~ 0.3273	0.2964 ± 0.0254^{a}	
	A. chevrieri	12	0.1000 ~ 0.2000	0.1565 ± 0.0325^{b}	
Head	*A. orestes*	14	0.2143 ~ 0.3889	0.3138 ± 0.0579^{a}	9.416**
	A. draco	16	0.2333 ~ 0.4545	0.3354 ± 0.0641^{a}	
	A. chevrieri	12	0.1111 ~ 0.3333	0.2317 ± 0.0722^{b}	
Back	*A. orestes*	11	0.2857 ~ 0.5000	0.4028 ± 0.0632^{ab}	4.875*
	A. draco	14	0.3529 ~ 0.5833	0.4341 ± 0.0741^{a}	
	A. chevrieri	10	0.2759 ~ 0.4444	0.3493 ± 0.0556^{b}	
Abdomen	*A. orestes*	14	0.2143 ~ 0.4706	0.3578 ± 0.0841^{a}	5.366**
	A. draco	16	0.2509 ~ 0.5143	0.3643 ± 0.0672^{a}	
	A. chevrieri	10	0.2308 ~ 0.3529	0.2800 ± 0.0372^{b}	
Forelimb	*A. orestes*	12	0.2727 ~ 0.5625	0.4184 ± 0.0888^{a}	5.232*
	A. draco	13	0.2941 ~ 0.5000	0.4128 ± 0.0598^{a}	
	A. chevrieri	13	0.2813 ~ 0.3913	0.3447 ± 0.0390^{b}	
Mixed#	*A. orestes*	61	0.2143 ~ 0.5625	0.3532 ± 0.0823^{a}	24.820**
	A. draco	71	0.2333 ~ 0.5833	0.3689 ± 0.0771^{a}	
	A. chevrieri	57	0.1000 ~ 0.4444	0.2707 ± 0.0882^{b}	

The five parts mixed as a whole to describe the characteristics of a particular species.

* $P < 0.05$, ** $P < 0.01$ (One-way ANOVA); Different superscript letters in each part indicate significant difference, $P < 0.05$ (LSD test for whisker, head, back, forelimb and mixed; Tamhane's test for abdomen).

As regards to the taxonomic status of *A. orestes*, we believe that it still requires more adequate evidence to establish *A. orestes* as a valid species at the present time. Our study only serves as a basic material for the research about taxonomic status of *A. orestes*. Further studies need to be done in order to answer whether *A. orestes* should be regarded as a valid species, a subspecies, a sibling species and an incipient species or only as a local population with some different characteristics of *A. draco*.

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