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中华姬鼠体组织化学成分的分析

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AN ANALYSIS ON BODY CHEMICAL COMPOSITIONS OF *APODEMUS DRACO*

在研究生态系统中的元素循环问题时，对每个生物组分的分析，通常是依据其生物量与元素含量的乘积。但是，许多因子又影响到个体和种群元素的含量，这些因子包括体尺大小、性别、繁殖状况、时间、空间和遗传变异等等。因此，元素含量及其变化的研究均有一定意义。

中华姬鼠(*Apodemus draco*)是亚热带山地常绿阔叶林鼠形啮齿类的绝对优势种。既然生态系统内一定营养层中优势种的能学研究在相当程度上可以代表该营养层的能学状况，那么中华姬鼠身体中的元素研究无疑对研究鼠形啮齿类在该生态系统元素循环过程中的地位有所助益。

研究方法

1987—1988年在云南省景东哀牢山亚热带湿性常绿阔叶林(北纬24°32′，东径101°01′，海拔2 400米)中，按季节分别于7月、10月、12—1月和4月活捕中华姬鼠67只。记录个体重量、年龄、性别、繁殖状况后作死亡处理。清水冲洗毛皮除去灰尘。血凝后去掉肠胃内含物。在低于70℃下干燥、称重、粉碎。然后，样品用H_2SO_4-$HClO_4$消化。用半微量凯氏定氮法测定样品中的全氮含量，HITACHI 170-3型原子吸收光度计测定钾、钠含量，PLASMA-200型等离子发射光谱仪测出其余元素含量。

结果和讨论

许多关于动物身体中的化学成分的报道，仅涉及了同器官、组织的元素组成和含量，而涉及整个兽类身体中元素组成的研究工作则比较少见。国内仅陈俨梅和吴德林做过这方面的工作。

Beyers等(1971, *Acta Theriologica*, Vol.16, No. 14)认为碾碎消化和整体消化的不同处理方式，对元素含量并无明显差异，本工作采用了后种处理方式。表1列出中华姬鼠身体中的7种元素干重含量。

表1 中华姬鼠元素组成(干重ppm)

Table 1 Elemental composition in *A. draco* (Dry weight ppm)

元素 Element	钙 Ca	钾 K	镁 Mg	氮 N	钠 Na	磷 P	铝 Al
平均值±标准误 M±SE	30778±2179 (13400—168200)	9285±198 (5060—12430)	1326±144 (640—6200)	56064±2029 (27000—103200)	3157±159 (190—5840)	22772±1508 (8700—107100)	1083±127 (242—8400)

正如上述，一些因素能够影响个体、种群的元素含量。大量研究证实，多种元素其含量呈现时间变化。Sella和Briese于1973年研究棉鼠(*Sigmodon hispidus*)的体组织化学成分时，发现铁、锌、铝、硼、钾、镁、钼、氮、钠、钡、磷等含量具有明显的季节差异，短尾鼩鼱(*Sorex araneus*)元素含量的季节变化相当显著。中华姬鼠元素含量的季节异同列表2。

* 元素测定、分析工作在本所分析室进行。邓向福、徐跃同志参加工作，哀牢山森林生态站提供支持，一并致谢。

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表 2 中华鼢鼠元素含量季节变化(干重, ppm)

Table 2 Seasonal variations of elemental concentrations in *A. draco* (Dry weight, ppm)

元素 Element		夏季 n=17 Summer	秋季 n=18 Autumn	冬季 n=14 Winter	春季 n=18 Spring	夏季 n=17 Summer
钙 Ca	平均值±标准误 M±SE	28523±1653 (13400—45400)	37033±7613 (20200—168200)	28512±1162 (16900—35340)	29972±1162 (20800—40600)	28523±1653 (13400—45400)
	概率 P		>0.20	>0.20	<0.01	>0.40
钾 K	平均值±标准误 M±SE	7315±304 (5056—9140)	9100±204 (7760—10560)	11260±151 (10430—12430)	9794±137 (9100—11400)	7315±304 (5056—9140)
	概率 P		<0.001	<0.001	<0.001	<0.001
镁 Mg	平均值±标准误 M±SE	942±30 (540—1240)	1924±507 (820—6200)	1206±38 (910—1440)	1183±30 (1000—1500)	942±50 (540—1240)
	概率 P		>0.05	>0.20	>0.50	<0.001
氮 N	平均值±标准误 M±SE	73235±3572 (37500—103200)	59416±2982 (39300—89200)	40200±1636 (30300—53000)	48833±2339 (27000—64500)	73235±3572 (37500—103200)
	概率 P		<0.01	<0.001	<0.01	<0.001
钠 Na	平均值±标准误 M±SE	4231±178 (2810—5840)	2953±97 (190—3820)	990±22 (860—1160)	3987±54 (3720—4580)	4231±178 (2810—5840)
	概率 P		<0.001	<0.001	<0.001	>0.20
磷 P	平均值±标准误 M±SE	15388±756 (18700—19300)	23766±4840 (13100—107100)	32034±641 (27780—37590)	21550±804 (15400—28100)	15388±756 (18700—19300)
	概率 P		>0.10	>0.10	<0.001	<0.001
铝 Al	平均值±标准误 M±SE	460±29 (242—621)	1591±429 (320—4200)	1202±71 (580—1560)	1072±55 (700—1500)	460±29 (242—621)
	概率 P		<0.025	>0.40	>0.10	<0.001

Note: Probability—P

从表2看出，所列7种元素含量均表现出季节性变化，但具体情况却又有不同：1）钾和氮的含量，无论任何季节均有显著差异；2）钙和镁的含量，仅分别于冬春季和春夏季具有显著差异；3）钠的含量仅春夏季没有差别；4）磷的含量，季节差异表现于冬春季和春夏季，而铝含量之差异则出现于春夏季和夏秋季。

一些作者研究过某些小啮齿类不同性别元素含量的差异情况。陈俨梅报道过达乌尔鼠兔（*Ochotona daurica*）、莫氏田鼠(*Microtus maximowiczii*)、狭颅田鼠(*M. gregalis*)各自一定年龄组内的元素含量存在两性间差异，但对黑线仓鼠(*Cricetulus barabensis*)却未发现元素含量在性别间的不同。Sella和Briese于1973年还发现棉鼠的铁、锰、铜和锶的含量具有明显的性别差异。作者研究中华鼢鼠几种元素含量时，并未发现性别间的不同(表3)。

繁殖状况是影响元素含量的因子之一。Briese 认为两性彼此间元素含量的差异与繁殖条件有关，

表 3 不同性别间元素含量比较(干重,ppm)

Table 3 Comparison of elemental concentrations between female and male(Dry weight, ppm)

元素 Element	雄 Male n=21 平均值±标准误 M±SE	雌 Female* n=24 平均值±标准误 M±SE	机率 P
钙 Ca	28107±1119 (20200—40500)	29890±1371 (13400—45700)	>0.50
钾 K	9630±269 (6170—11070)	9091±379 (6320—11730)	>0.60
镁 Mg	1560±393 (880—1410)	1155±50 (540—1570)	>0.20
氮 N	57171±3561 (35400—103200)	54875±2946 (30300—85800)	>0.50
钠 Na	3267±286 (860—4740)	2913±246 (930—4610)	>0.20
磷 P	21656±1356 (13100—34660)	22426±1362 (8700—33010)	>0.50
铝 Al	1283±356 (264—8400)	916±70 (282—1440)	>0.20

* 不包括繁殖雌性 No including breeding female

表 4 不同繁殖条件下成年雌性元素含量(干重, PPm)

Table 4 Elemental concentration in adult females of *A.draco* in different breeding conditions (Dry weight, ppm)

元素 Element		哺乳 n=12 Lactating	未繁殖 n=12 No breeding	怀孕 n=6 Pregnancy	哺乳 n=12 Lactating
钙 Ca	平均值±标准误 M±SE	39925±11266 (16900—168200)	30226±2220 (13400—45700)	26950±1183 (22700—32000)	39926±11266 (16900—168200)
	概率 P	<0.05	>0.20	<0.05	
钾 K	平均值±标准误 M±SE	9336±534 (5060—12000)	8572±615 (5320—12430)	8611±362 (7460—9600)	9336±534 (5060—12000)
	概率 P	>0.20	>0.60	>0.40	
镁 Mg	平均值±标准误 M±SE	1496±414 (590—6200)	1136±81 (540—1500)	1026±48 (840—1200)	1498±414 (590—6200)
	概率 P	>0.40	>0.40	>0.4	
氮 N	平均值±标准误 M±SE	56016±4570 (37300—85600)	61283±3456 (30300—70600)	56366±9318 (27000—81200)	56016±4570 (37300—85800)
	概率 P	>0.40	>0.50	>0.50	

续表 4 Continue table 4

元 素 Elemant		哺乳n = 12 Lactating	未繁殖n = 12 Nobreeding	怀孕n = 6 Pregnancy	哺乳n = 12 Lactating
钠 Na	平均值±标准误 M±SE	2685±422 (190—4640)	2859±315 (1010—4110)	4511±253 (3870—5840)	2685±422 (190—4640)
	概率 P	>0.50	<0.005	<0.005	
磷 P	平均值±标准误 M±SE	20653±2493 (9200—107100)	22374±2158 (8700—32600)	16833±1214 (13800—22500)	20653±2493 (9200—107100)
	概率 P	>0.50	>0.10	>0.20	
铝 Al	平均值±标准误 M±SE	1272±274 (621—4200)	930±110 (377—1440)	753±106 (389—1100)	1272±274 (621—4200)
	概率 P	>0.20	>0.20	>0.20	

Note: Probability—P

表 5 不同年龄组元素含量比较*(干重，ppm)

Table 5 Comparison of elemental concentrations in different age groups (Dry weight, ppm)

元 素 Element	幼年 Juvenile n = 23 平均值±标准误 M±SE	成年* Adults n = 22 平均值±标准误 M±SE	概 率 Probability
钙 Ca	27392±1146 (20200—46400)	30235±1424 (13400—45700)	>0.20
钾 K	9573±238 (6380—11730)	9102±430 (5320—11430)	>0.20
镁 Mg	1516±351 (710—9400)	1157±50 (540—1500)	>0.20
氮 N	60152±3616 (35400—103200)	51550±2449 (30300—64500)	>0.06
钠 Na	3166±278 (910—4740)	2977±251 (860—4800)	>0.50
磷 P	21388±1195 (13000—32750)	22778±1513 (8700—34860)	>0.40
铝 Al	1212±325 (464—8400)	907±90 (242—1500)	>0.20

* 未包括繁殖雌性 No including breeding female

Simkiss则发现怀孕白鼠钙含量高，而哺乳白鼠钙含量极低。中华姬鼠成年雌性不同繁殖状况下的元素含量列表 4。

表 4 表明，哺乳组钙含量显著高于未参加繁殖成年组的钙含量；怀孕组钠含量显然高于未参加繁殖组的钠含量；而哺乳组和怀孕组比较，钙含量较高，钠含量却又显然低下。

年龄对于研究元素含量是一个重要的变量。一些作者研究过某些鼠种出生后发育期间身体中的元素成分的变化。陈俨梅指出黑线仓鼠亚成年组的磷、钙、镁含量显著高于幼年组；狭颅田鼠幼年组磷含量高于成年组。Briese发现野外捕获的棉鼠，其许多元素含量随年龄增长发生显著的变化。表3揭示出，中华姬鼠所列几种元素含量并无性别间的差异。这样，当研究年龄因素时则可以不考虑性别的影响。表5列出中华姬鼠成幼年龄组间各身体中的元素含量及互相间的比较结果。

表5揭示出，中华姬鼠成年组和幼年组间所列元素的含量并不存在显著差异。陈俨梅同样发现鼠兔和莫氏田鼠的成年组和幼年组间无元素含量差别。这个现象，与上述性别对身体中的元素含量影响类似，可能暗示着年龄对身体中的元素含量影响是随动物种类而异。

关键词 元素含量；元素含量变化；中华姬鼠

Key words *Elemental concentration; Variation of elemental concentration; Apodemus draco*

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BRIEF INTRODUCTION OF THE SEVENTH INTERNATIONAL SNOW LEOPARD SYMPOSIUM

第七届国际雪豹学术讨论会简况

The Seventh International Snow Leopard Symposium, sponsored by Northwest Plateau Institute of Biology, Chinese Academy of Sciences (NPIB, CAS), the Agriculture and Forest Bureau of Qinghai Province (AFBQP), the International Snow Leopard Trust (ISLT), was hold during 25 to 30 of July, 1992 in Xining, China. 46 participants from America, Canada, Norway, Switzerland, India, Pakistan, Nepal, Mongolia, Tajikistan, Kyrgyzstan, Russia, Britain, ect. 14 countries and 28 Chinese participants from zoos and forest management departments attended the symposium. 78 research papers were presented. The theme of the symposium was "People, Snow Leopard, Park". From 26 to 30, 7 sections were hold. The papers were divided into three parts: Management of Captive Snow Leopard Populations; Field Studies of Snow Leopard and their Prey Species; Poeple, Snow Leopard, Park. In the opening ceremony, Province Governor Jin Jipeng, Vice Governor Banmadanzeng of QP, Vice Director Zhang Changxin from AFBQP, Prof. Du Jizeng, Director of NPIB, CAS, President Helen Freeman of ISLT gave speech respectively. Through 5 days exchange and discussion, the symposium came to a resolusion. It is as the following:

1. Based on critical habitat and ecological needs, possibilities should be explored to identify and establish transboundary parks both within provinces of each country or between different countries, such as Khunjerab National Park on the Pakistan side and Taxkorgan Nature Reserve on the China side, while Sagarmatha National Park in Nepal and Qomolangma Nature Preserve in Tibet of China.

2. In view of both national and international trade in snow leopards and their parts, the symposium urges all countries to evolve legislation if not existing already and actively enforce hunting laws and CITIES rules and to train, educate and equip all officials responsible for preserving and managing wildlife.

3. Because of the fragmented nature of snow leopard populations, the symposium urges all countries having snow leopard populations to join SLIMS for gathering fundamental data which could then be used in critical and crucial decisions regarding the conservation and management of snow leopards.

4. Realizing the critical role of communities, especially graziers, in the overall survival of snow leopard, the symposium urges all governments in the snow leopard zone to initiate eco-development programs within and around the parks for the economic uplift of such communities, so that the existing conflict between them and snow

leopard conservation can be mitigated and subsequently resolved.

5. Realizing the significance of livestock losses because of snow leopard predation the symposium urges all respective governments in the snow leopard zone to explore appropriate ways of economic incentives/compensation for the livestock owners who suffer losses because of snow leopard predation.

6. Certain countries in the snow leopard zone, as well as certain provinces within a country, like Qinghai Province in China, have no specific conservation programs for snow leopard. Such programs should be initiated, with the help of international funding agencies if local full funding is not available.

7. On the request of the Russian delegation to the Seventh International Snow Leopard Symposium, the Mongolian scientists will study the feasibility of creating a corridor between Gobi-Altai and Southern Siberia. If feasible, a proposal will be prepared for the legal establishment of such corridor.

8. Keeping in view the importance of the Altai Mountains for snow leopards, the symposium urges the government of Mongolia to continue their bio-ecological studies.

9. Keeping in view the availability of good snow leopard populations in all of the former socialist-oriented countries, the symposium urges these new governments to initiate joint cooperative programs for the conservation and management of snow leopards and their habitats.

10. Realizing the importance of Kokoxili as habitat of rare animals such as snow leopard, wild ass, Tibetan gazelle, wild yak, etc., the symposium urges the government of Peoples Republic of China to create a nature reserve in Qinghai Province covering approximately 83 500 sq km. (39 degrees, 20 minutes to 36 degrees north latitude, 89 degrees 30 minutes to 93 degrees east), and also considering the reserves in Sichuan and Gansu Provinces: Arksai County Reservation Area; Liqiaru Reservation Area; Arba Reservation Area; Ganzi Reservation Area; Baoxin Reservation Area.

11. Realizing the proven and potential negative impacts of organo-chlorines and other related compounds on upper trophic level predators such as snow leopard, the symposium urges countries in the snow leopard zone, especially the Himalayan region, to abandon the use of such toxic and persistent pesticides.

12. Realizing the fact that most of the nature reserves and national parks in the snow leopard zone have no management plans, the symposium urges all the government to initiate efforts to develop such plans, and to implement if such plans, for example that of Pin Valley National Park in India, are already prepared.

13. Realizing the need for cooperative efforts to protect snow leopards both in the wild and captivity, the symposium urges all governments and scientists working on snow leopards to exchange information and material on the subject.

14. Considering the abundance of captive snow leopards and genetic variability, in zoos of North America and Europe, the symposium encourages the zoos in the above region to assist all qualified zoological gardens to obtain their snow leopards through cooperative programs before considering taking them from the wild.

15. Realizing the fact that most of the resolutions of the Snow Leopard Symposium have been difficult to implement and monitor, the participants of the Seventh International Snow Leopard Symposium urges the Snow Leopard Trust to create a steering committee to follow on the recommendations of each symposium.

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