

## Chapter 10

### A NEW MODEL ORGANISM FOR REGENERATION, SPINY MOUSE (GENUS: *ACOMYS*)

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#### ◆ Introduction

Rodentia is the largest ordo of the mammal class with 29 families, more than 400 genera and over 2000 species<sup>(1)</sup>. They are approximately 40% of the mammals living on the earth<sup>(2,3)</sup>. They spread over a very large area in the world. These animals live on land in many different habitats such as tree, subsoil and semi-aquatic. Therefore, various adaptations have occurred on their bodies according to living areas. For instance; the eyes of ones who have lived under ground have remained into the skin or totally become blind. They feed as herbivores or omnivores<sup>(4)</sup>.

The most important diagnostic character that distinguishes the Rodentia order from the others is the diastema gap caused by the loss of canine teeth. The diastema space is located between the upper incisors and the first molar and is used to collect nutrients. There are two incisors in front of both jaws, which are common features of all rodents. These teeth are rootless, continuously growing long teeth with only enamel on their front surfaces. These teeth have to gnaw for a period of time, otherwise they will elongate and cause the animal to be unable to open its mouth and die by not being fed. These creatures are called “rodents” because of these features.

As mentioned above, rodents live in every territories of the world and adapt to all kinds of life. They occupy a vital part as wild mammals in the natural life that forms the immediate environment for humans. Though rodents are the origin of many diseases like leptospirosis, plague, tularaemia, yersiniosis, lymphatic choriomeningitis, lassa fever, hemorrhagic fevers with renal syndrome etc. many types of those species have common living area with people<sup>(5)</sup>. Because of this reason, they are referred to ugly creatures by most people. However, some species in rodents are the center of attention of researchers in terms of having characteristics that will benefit humanity. The genus *Acomys*, which has the ability to regenerate among mammals and draws attention with the spine-like hairs of its dorsum, is among the most exotic creatures living in different regions of the world.

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## ◆ REFERENCES

1. Wilson DE, Reeder DAM. 2005. Mammal species of the World. A taxonomic and geographic reference. 3rd ed. John Hopkins Univ. Press, Baltimore.
2. Wilson DE, Lacher TE, Mittermeier RA. 2016. Handbook of the Mammals of the World. Vol. 6. Lagomorphs and Rodents I. Lynx Edicions. Barcelona.
3. Wilson DE, Lacher TE, Mittermeier RA. 2017. Handbook of the Mammals of the World. Vol. 7. Rodents II. Lynx Edicions. Barcelona.
4. Demirsoy A. 1992. Yaşamın Temel Kuralları, Omurgalılar/Amniyota (Sürüngenler, Kuşlar, Memeliler), 942 s, Ankara.
5. WHO World Health Day. About Vector borne diseases. (Internet)
6. Haughton CL, Gawriluk TR, Seifert AW. 2016. The biology and husbandry of the African spiny mouse (*Acomys cahirinus*) and the research uses of a laboratory colony. J Am Assoc Lab Anim Sci, 55, 9–17.
7. Pinheiro G, Prata DF, Araújo IM, et al. 2018. The African spiny mouse (*Acomys spp.*) as an emerging model for development and regeneration. *Laboratory Animals*, 52(6), 565– 576.
8. Harrison DL, Bates PJJ. 1991. The Mammals of Arabia. Harr. Zool.Mus.pub.sec. Edition. England
9. Barome PO, Monnerot M, Gautun JC. 2000. Phylogeny of the genus *Acomys* (Rodentia, Muridae) based on cytochrome *b* mitochondrial gene: implications on taxonomy and phylogeography. *Mammalia*, 64, 423-438.
10. Bate DMA. 1903. On the occurrence of *Acomys* in Cyprus. *Ann. Mag. Nat. Hist.* , II:565-567
11. Musser GG, Carleton MD. 2005. Superfamily Muroidea. In: Wilson, D. E., Reeder, DA. M. (eds.) *Mammal species of the World. A taxonomic and geographic reference*. 3rd ed., Vol. 2. John Hopkins Univ. Press, Baltimore, pp: 894-1531.
12. Musser GG, Carleton MD. 1993. Family Muridae. In: Wilson, D. E., Reeder, DA. M. (eds.) *Mammal species of the World. A taxonomic and geographic reference*. 2nd ed. Smithsonian Institution Press, Washington, 501-755.
13. Krystufek B, Vohralik V. 2001. Mammals of Turkey and Cyprus. Introduction, Checklist, Insectivora. *Annales Majora*, Koper.
14. Barome PO, Lymberakis P, Monnerot M, et al. 2001. Cytochrome b sequences reveal *Acomys minous* (Rodentia, Muridae) paraphyly and answer the question about the ancestral karyotype of *Acomys dimidiatus*. *Mol Phylogenet Evol*, 18, 37–46.
15. Agulnik SI and Silver LM. 1996. The Cairo spiny Mouse *Acomys cahirinus* shows a strong affinity to the Mongolian gerbil *Meriones unguiculatus*. *Mol Biol Evol* 13, 3–6.
16. Barome PO, Monnerot M, Gautun JC. 1998. Intrageneric phylogeny of *Acomys* (Rodentia, Muridae) using mitochondrial gene cytochrome b. *Mol Phylogenet Evol* 9, 560–566.
17. Martin Y, Gerlach G, Schlotterer C, et al. 2000. Molecular phylogeny of European muroid rodents based on complete cytochrome b sequences. *Mol Phylogenet Evol*, 16, 37–47.
18. Chevret P, Denys C, Jaeger JJ, et al. 1993. Molecular evidence that the spiny mouse

- (*Acomys*) is more closely related to gerbils (Gerbillinae) than to true mice (Murinae). Proc Natl Acad Sci USA 90, 3433–3436.
19. Wilson AC, Ochman H and Prager EM. 1987. Molecular time scale for evolution. Trends Genet, 3, 241–247.
  20. Krystufek B, Vohralik V. 2009. Mammals of Turkey and Cyprus – Rodentia II. Bibliotheca Annales Majora, Ljubljana.
  21. Steppan SJ, Adkins RM, Spinks PQ, et al. 2005. Multigene phylogeny of the Old World mice, Murinae, reveals distinct geographic lineages and the declining utility of mitochondrial genes compared to nuclear genes. Mol Phylogenet Evol, 37, 370–388.
  22. Fabre PH, Hautier L, Dimitrov D, et al. 2012. A glimpse on the pattern of rodent diversification: A phylogenetic approach. BMC Evol Biol, 12: 88.
  23. Gonet AE, Stauffacher W, Pictet R, et al. 1966. Obesity and diabetes mellitus with striking congenital hyperplasia of the islets of langerhans in spiny mice (*Acomys cahirinus*). Diabetologia, 1, 162–171.
  24. Shafir E, Ziv E, Kalman R. 2006. Nutritionally induced diabetes in desert rodents as models of type 2 diabetes: *Acomys cahirinus* (spiny mice) and *Psammomys obesus* (desert gerbil). ILAR J, 47, 212–224.
  25. Kumar S, Singh R, Vasudeva N, et al. 2012. Acute and chronic animal models for the evaluation of anti-diabetic agents. Cardiovasc Diabetol, 11, 9. 574 Laboratory Animals 52(6)
  26. O'Connell B, Moritz K, Walker D, et al. 2013. Treatment of pregnant spiny mice at mid gestation with a synthetic glucocorticoid has sex-dependent effects on placental glycogen stores. Placenta, 34, 932- 940.
  27. O'Connell BA, Moritz KM, Roberts CT, et al. 2011. The placental response to excess maternal glucocorticoid exposure differs between the male and female conceptus in spiny mice. Biol Reprod, 85, 1040- 1047.
  28. Hutton LC, Ratnayake U, Shields A, et al. 2009. Neuropathology and functional deficits in a model of birth asphyxia in the precocial spiny mouse (*Acomys cahirinus*). Dev Neurosci, 31, 523–535.
  29. Ireland Z, Castillo-Melendez M, Dickinson H, et al. 2011. A maternal diet supplemented with creatine from midpregnancy protects the newborn spiny mouse brain from birth hypoxia. Neuroscience, 194, 372–379.
  30. Brunjes PC. 1990. The precocial mouse, *Acomys cahirinus*. Psychobiology, 18, 339–350.
  31. Dickinson H, Ireland ZJ, LaRosa, et al. 2013. Maternal dietary creatine supplementation does not alter the capacity for creatine synthesis in the newborn spiny mouse. Reprod Sci, 20, 1096–1102.
  32. Ellery SJ, Ireland Z, Kett MM, et al. 2013. Creatine pretreatment prevents birth asphyxia-induced injury of the newborn spiny mouse kidney. Pediatr Res, 73, 201–208.
  33. Bellofiore N, Ellery SJ, Mamrot J, et al. 2017. First evidence of a menstruating rodent: The spiny mouse (*Acomys cahirinus*). Am J Obstet Gynecol, 216, 40.e1–40.e11.
  34. Brant JO, Lopez M-C, Baker HV, et al. 2015. A comparative analysis of gene expression profiles during skin regeneration in *Mus* and *Acomys*. PLoS One, 10, e0142931.
  35. Matias Santos D, Rita AM, Casanellas I, et al. 2016. Ear wound regeneration in the African spiny Mouse *Acomys cahirinus*. Regeneration (Oxf), ;: 52–61.
  36. Seifert AW, Kiama SG, Seifert MG, et al. 2012. Skin shedding and tissue regeneration

- in African spiny mice (*Acomys*). *Nature*, 489, 561–565.
37. Gawriluk TR, Simkin J, Thompson KL, et al. 2016. Comparative analysis of ear-hole closure identifies epimorphic regeneration as a discrete trait in mammals. *Nature Commun*, 7, 11164.
  38. Brant JO, Yoon JH, Polvadore T, et al. 2016. Cellular events during scar-free skin regeneration in the spiny mouse, *Acomys*. *Wound Repair Regen*, 24, 75–88.
  39. Simkin J, Gawriluk TR, Gensel JC, et al. 2017. Macrophages are necessary for epimorphic regeneration in African spiny mice. *Elife*, 6, e24623.
  40. Sandoval AGW. and Maden M. 2020. Regeneration in the spiny Mouse, *Acomys*, a new mammalian model. *Current Opinion in Genetics and Development*, 64, 1-6.
  41. Maden M and Varholick JA. 2020. Model systems for regeneration: the spiny Mouse, *Acomys cahirinus*. *Development* Doi: 10.1242/dev.167718
  42. Yoon JH, Cho H, Garrett TJ, et al. 2020. Comparative proteomic analysis in scar-free skin regeneration in *Acomys cahirinus* and scarring *Mus musculus*. *scientific reports*, 10:166 doi.org /10.1038/s41598-019-56823-y
  43. Streeter KA, Sunshine MD, Brant JO, et al. 2019. Molecular and histologic outcomes following spinal cord injury in spiny mice, *Acomys cahirinus* *J Comp Neurol*, 528, pp. 1535-1547
  44. Spitzenberger, F., 1978. Die Stachelmaus von Kleinasien. *Acomys cilicicus* n. Sp. (Rodentia, Muridae). *Ann. Naturhistor. Mus. Wien*, 81: 443-446
  45. Kıvanç E, Mutlu Eyison H, Kıralp S. Et al. 2013. Reproductive biology of the *Acomys cilicicus* Spitzenberger, 1978 (Rodentia: Muridae) in Turkey. *Turk. J. Zool.* 37, 133-142.
  46. Kıvanç E, Mutlu Eyison H, Kıralp S, 2017. The distribution, habitat and conservation status of the Turkish spiny mouse, *Acomys cilicicus* Spitzenberger, 1978. *Journal of Entomology and Zoology Studies*, 5(2), 1443-1447