

# BioResource Now!

Issue Number 8 November 2012

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Research and Bioresources <NO.12>



# Origin of Albino Laboratory Rats

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Albino laboratory rats are one of the most frequently used laboratory animals across the world. However, the origin of albino laboratory rats remains unclear. We studied DNA samples for 117 albino rat strains that have been used worldwide and found that all the strains share the same albino mutation. This finding suggested that the albino mutation had very likely occurred originally in the hooded rats. In other words, it can be presumed that hooded rats were first used in the second half of the 19th century and earlier when rats were used as laboratory animals and that an albino rat emerged as a product of the breeding of the hooded rats. Since the offspring of this albino rat (designated Adam or Eve) were of a gentle nature and became domesticated, their descendants have been widely used as laboratory animals ever since.

## Albino and Hooded Rats

Since the middle of the 19th century, albino and hooded rats have been mainly used in research laboratories (Fig. 1). In particular, albino rats have been more widely used as laboratory animals. Therefore, the albino rat became synonymous with "laboratory rat." Although the term "albino rat" is commonly used at present, the rat has been called white rat, Daikoku rat, and ratte in the past.



Fig. 1: Albino rat (left) and hooded rat (right)

The hooded rat is a hooded mutant of rats. When the hooded mutation is homozygous, the color pigment distribution of the hair changes; consequently, the rat's ventral and posterior body remains nonpigmented

and appears white. Since the pigments are distributed only over the head and the brachial region of a rat's body, the rat appears as if wearing a hood. Therefore, this pattern is called "hooded."

## Origin of the Albino Rats

At present, more than 100 albino rat strains exist, and at least several millions of albino rats are used in laboratories every year. It is yet unknown whether these strains share the same albino mutation or whether different strains possess different albino mutations. It has also remained unclear whether the albino rat or the hooded rat was the first to be discovered and domesticated.

In old scientific literature, both albino and hooded rats have been mentioned, but the origins of these rats have not been clearly described. For example, Donaldson (1915) from the Wistar Institute documents his experience as follows [1]:

"I could obtain wild or domesticated rats. The latter consisted mainly of albino or hooded rats. It was unknown whether the albino rats were derived from a single or multiple ancestors. It was also unclear whether albino rats were related to the rat colonies in Europe."

## Records that Remain in Genes

We attempted to seek the origin of the albino rat by using the latest genetic analysis technologies. We examined the existence of the albino mutation (a gene that causes albinism) in 117 albino rat strains collected from all parts of the world through the National Bio Research Project for the Rat in Japan (NBRP-Rat). Subsequently, we found that all the strains shared the same albino mutation. In other words, several millions of albino rats used worldwide have descended from a single ancestor [2].

We also found that the coat-color pigmentation of the hooded rat is caused by a mutation in the Kit gene, and we investigated whether this mutation existed in the 117 albino rat strains. We found that all the albino strains possessed the mutation in the Kit gene [2]. Based on the above results, the following 2 points can be considered:

- ① An ancestor (designated Adam or Eve) of the albino rats existed.
- ② The albino rats have descended from hooded rats.

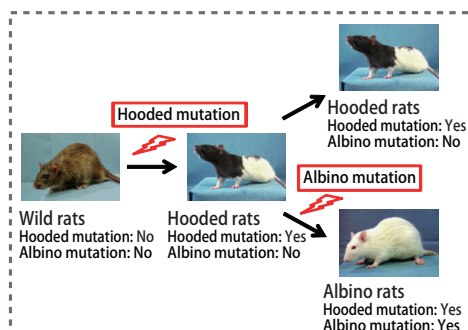


Fig. 2: Relationship between the albino and hooded rats

Albino rats throughout the world possess the hooded mutation. This fact can be easily explained as follows: (1) the hooded mutation first occurred in wild rats, resulting in the emergence of the hooded rat; and (2) the albino mutation then occurred in the hooded rat, resulting in the emergence of the albino rat.

## New Mystery: What Is the Origin of the Hooded Rat?

The present study has revealed the origin of the albino rat and raised a new question: "what is the origin of the hooded rat?" One of the approaches to solving this mystery is genome comparison. There is a possibility that genetic information of a Kit mutant rat remains in the genome area near the Kit mutation. By comparing the genome area around the Kit mutation in laboratory, fancy, and wild rats from across the world, the relationship between the rat type and the Kit mutation may be elucidated.

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Reviewing published literature is another approach for determining the relationship between the albino rats and hooded rats. William Ernest Castle, once a professor at the Harvard University, published a paper in the *American Naturalist* (1914) which mentioned that the hooded rat was called "Japanese rat" in the 1900s [3]. In Japan, there was a widespread practice of keeping rats as a domesticated pet during the Edo period. Publication of guidebooks such as *Youso Tamanokakehashi* (1775)

and Chingan Sodategusa (1787) for keeping rats as pets is evidence of this practice [4]. We believe that one or more Japanese hooded rats might have migrated to Europe or the Americas to become the Adam or Eve of the laboratory rats. Thus, it can be considered that "Japan has been advocating scientific research by using rats as laboratory animals" together with NBRP-Rat in the 21st century.

**References**

1. Donaldson HH (1915) The Rat data and reference tables.
2. Kuramoto T, Nakanishi S, Ochiai M, Nakagama H, Voigt B, et al. (2012) Origins of albino and hooded rats: implications from molecular genetic analysis across modern laboratory rat strains. *PLoS One* 7: e43059.
3. Castle WE (1914) Some New Varieties of Rats and Guinea-Pigs and Their Relation to Problems of Color Inheritance. *The American Naturalist* 48: 65-73.
4. Kuramoto T (2011) Yoso-tama-no-kakehashi; the first Japanese guidebook on raising rats. *Exp Anim* 60: 1-6.

**Using FileMaker on an iOS Device**

Many of you may manage strain data using FileMaker as a standalone application on your PC. In this issue, I would like to introduce the use of FileMaker on an iPhone or iPad (hereafter referred to as iOS devices).

**What you will need**

You will need to have the FileMaker Pro 12 and FileMaker Go 12 (free) setups for iOS devices.

There are different versions of FileMaker Go 12 for the iPhone and iPad, both of which can be downloaded for free from the App Store. If your currently installed FileMaker Pro version is 11, 10, 9, 8.5, 8, or 7, you will need FileMaker Go 11, which is not a free app.

**Prepare a database for sharing on FileMaker Pro**

First, create a new database in FileMaker Pro. In this example, we create a database titled "Strain Photo Manager" that has three fields: date, strain name, and photograph. The date and strain name are text-type fields, whereas an object-type field is used for storing photographs (Fig. 1).

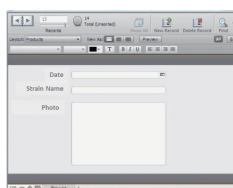


Fig. 1. FileMaker Pro screen layout.

Next, choose File > Sharing > FileMaker Network from the menu. Switch network sharing to "ON" (Fig. 2-A), select the currently open file, "strain photo manager.fmp12" (Fig. 2-B), and select "All users" in the "Network access to file" section of the network settings dialog box (Fig. 2-C).

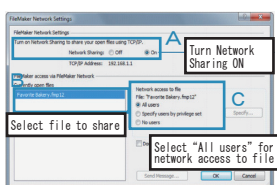


Fig. 2. FileMaker network settings

**Using the database from an iOS device**

Launch the FileMaker Go app on your iOS device, and tap on "Open File Browser" (Fig. 3-1). Tap on "Add Host" (Fig. 3-2), enter the IP address of the computer where FileMaker Pro is installed, and save the information (Fig. 3-3).

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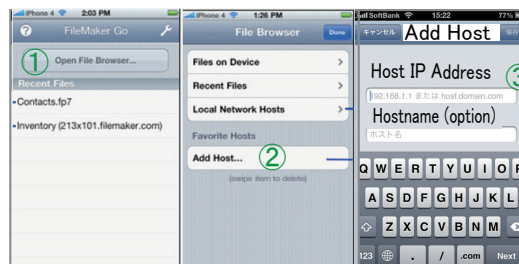


Fig. 3: 1 FileMaker Go main screen, 2 file browser, 3 "add host" screen

To start using the database from your iOS device, tap on the IP address in the file browser (Fig. 4-4). Next, tap on the database that you created in FileMaker Pro (Fig. 4-5) to open the input form (Fig. 4-6). For the photo field, you can take a new photo with your iOS device or select one that was taken previously (Fig. 4-7).



Fig. 4: 4 File browser, 5 choosing the database, and 6, 7 database input form

In the above example, it is assumed that the iOS device and FileMaker Pro database are on the same network connected through a wireless LAN. In places such as at experimental fields where wireless LAN is unavailable, you will need to connect to the database through a 3G network. For this, you will also need to install FileMaker Server. By using the FileMaker Server, you can enter data flexibly during your daily fieldwork and even during specimen collection trips.

You can download the trial version of FileMaker Pro and FileMaker Server from the FileMaker website, and FileMaker Go 12 is available for free at the App Store. Why not give them a try? (Masakazu Saga)

**Recommended Book! <NO.11>**



**"Of Flies, Mice, and Men"**

Written by Francois Jacob and translated by Shoji Hara (Misuzu Shobo, 2000)

The author of this book is famous as one of the originators of the "Jacob and Monod's operon model," a model for gene expression control in bacteria. Francois Jacob shared the 1965 Nobel Prize in Physiology or Medicine with Jacques Mond. At first glance, the book appears to be a memoir chronicling the research of a Nobel Prize winner, along with a collection of witty and intellectual essays. On continued reading, the theme of "paradox revealed by biology in the 20th century" emerges as the backbone of the book. The paradox propounds how homeotic genes are commonly found to play a role in the embryogenesis of both flies and mice and the surprising disclosure that fishes and mammals, whose morphological features differ greatly from each other, can possess similar genes. This surprising fact was published after the discovery of homeotic genes. These findings are said to have brought a paradigm shift in biology. An indication that the old paradigm contains "the synthetic theory of evolution" is considered important. A typical explanation that a gene mutation brings changes in enzymes and causes variation in individual characteristics (phenotype) is no longer valid. The author mentions that a simple continuity between phenotype and genotype is no longer sufficient; all organisms bear a resemblance to Mecanno (a construction toy) in which limited types of blocks are combined to construct a toy building or a vehicle. Similar to Mecanno, all the organisms are the results of large-scale combinations of limited types of modules consisting of genes and proteins. The book also emphasizes that organisms have evolved by slightly changing the combinations of those modules (bricolage) (K. N.).

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**Editor's Note**

The newsletter of this month introduces research results peculiar to a resource center. Books published in Japan more than 200 years ago, a paper published in the United States about 100 years ago, and the DNA analysis results obtained using the latest technologies seem to be connected with each other. I can speculate that a Japanese hooded rat crossed the oceans to become an ancestor of the modern-day laboratory rats (Y. Y.).

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