

MINI REVIEW

China is facing serious experimental monkey shortage during the COVID-19 lockdown

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Abstract

This report aims to analyze the experimental monkey shortage generated by the COVID-19 lockdown. The supply capability of the monkey breeding farms is insufficient to meet demand, and the sales prices have skyrocketed since 2018. The contradiction will be further aggravated with import prohibition although the countermeasures suggested.

KEYWORDS

COVID-19 lockdown, monkey, shortage

1 | INTRODUCTION

The outbreak of the COVID-19, whose first cases were officially confirmed in late December 2019 in China and which rapidly developed into a pandemic¹ and has posed great threats to public health as well as global economies.² To control the COVID-19 epidemic, strictly restriction measures which called "COVID-19 lockdown" have been performed to reduce the threat to national security and public health by the Chinese government, the prohibition of the monkey trade also included. We analysis the influences of the experimental monkey shortage generated by the COVID-19 lockdown in China.

1.1 | Delay the monkey breeding colonies optimization process

The experimental monkeys in China mainly include cynomolgus monkeys and rhesus monkeys, the former are alien species imported from the Southeast Asia countries³, while the latter are the native species that are bred locally. There are nearly about 0.3million monkeys totally in breeding farms in China (80%–85% are cynomolgus monkeys) at a rough estimate presently. China has become the world's largest monkey breeding country, occupied about 70% monkeys imported to the United States each year. The Figure 1 has

exhibited the amounts of domestic and foreign sales of experimental monkeys in 2010–2020.

From 2000 to 2009, many cynomolgus monkeys have been imported in China. Since 2010, ensuring the balance between the supply and demand, the Chinese government began to control and further prohibit the cynomolgus monkey importation. The ban has lasting for nearly about 10 years. The disadvantage may cut off access to the genetic diversity required to maintain the breeding colonies would eventually lead to supply problems and the long-term impact of the biomedical research.⁴

The demand subsequently fell in global slump for two years (2011–2012); fortunately, the gradual demand recovery started from 2013 and continued to rise yearly, the sales price soared rapidly. The shortage is worsening yearly, and it has become difficulty to purchase enough monkeys to do studies. The shortage and high cost have created a bottleneck in biomedical research,⁵ especially to the CROs which wins by cost and service.⁶

The monkey importations were allowed in 2019, but it is just a brief opening period. When the COVID-19 outbreak in 2020, based on the pandemic is thought to have a zoonotic source, although the original wildlife reservoir has not yet been identified⁷ and may related to the wildlife trade,⁸ the import and export trade of live animals including monkeys closed.

Since March 2020, ensuring support COVID-19 vaccines development, the domestic monkey sale and transit has been allowed, but the import and export business still prohibited.

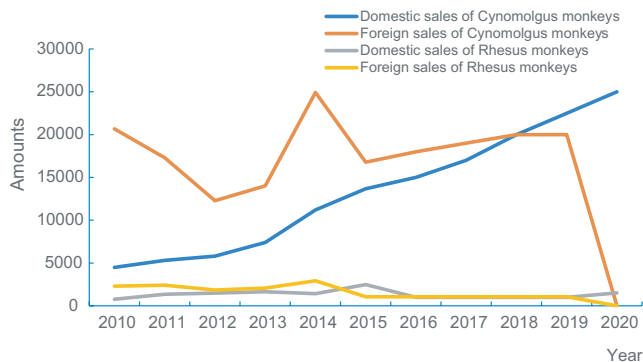


FIGURE 1 The amounts of domestic and foreign sales of cynomolgus monkeys and Rhesus monkeys in 2010-2020

1.2 | Deteriorate the acute experimental monkey shortage

In response to the COVID-19 pandemic, over 200 vaccine candidates are currently in development.⁹ Normally, vaccine development usually requires several years of preclinical and clinical stages of evaluation and requires strict regulatory approvals before it can be manufactured in bulk and distributed.¹⁰ COVID-19 vaccines have been developed at an unprecedentedly rapid speed.¹¹ Vaccines are usually first evaluated in a preclinical phase using appropriate animal models *in vivo*.

The animals likely to carry the most weight in assessing potential vaccines are monkeys due to their close genetic relationship to humans and often makes monkeys the gate keeper to clinical trials.¹² Thus, a large number of experimental monkeys are required in the preclinical trials.

As mentioned above, the monkey supply will become more and more limited due to the breeding colonies aging and low-birth rate. The capability cannot meet the predicted increase in demand. The most effective measure is to import foreign provenances from origin countries. The outbreak of COVID-19 has discontinued the importations. The experimental monkey shortage will be deteriorated more seriously especially the cynomolgus monkeys. This will have a long-term impact on biomedical research and many monkey studies will be terminated.

1.3 | Push up the selling price precipitously

The contradiction between the supply and demand will get worse and the sales price has skyrocketed from US Dollar 1,800 per monkey in 2018 to US Dollar 7,000 per monkey in 2020. It is a foregone conclusion that the selling price will keep rising.

1.4 | Promoting industrial transfer and upgrading of the breeding farms

More and more research institutions have and will start to strengthen the partnership with the monkey breeding farms, and also plan to construct their own monkey breeding farms.

The research institutions will entrust and transfer some studies to the farms, because this will reduce the experiment cost with no monkey transportation. The farms' owners should take advantage of these collaborative opportunities to upgrade their research services capacity and physical infrastructure. This is the precious opportunity to assist farms upgrade from monkey resources provision to experimental services provision.

1.5 | Suggestions for improvement to the experimental monkey industry

Firstly, China should devote its resources to address immediate scientific research needs, the escalating monkey shortage calls for the government to manage it as a strategic resource, support to construct several nation-sponsored centers.

Secondly, it should be noted that the most effective solution to solve this dilemma is to import the monkey provenances from the origin countries. The industry has been calling for to allow the monkey importation to ease the shortage. Meanwhile, the Chinese government has decided to support Hainan in building an introduction and transit base of global animal and plant germplasm resources, this may be a good chance to open importation moderately under the national quarantine and regulated by the CITES.¹³

Thirdly, we have realized that the monkey breeding industry with high-threshold, high-investment, and long-payback period characteristics and received lessons to strike a balance between short-term benefits and long-term planning. Thus, it is essential to establish a long-term population maintenance and breeding plan, so as to let many female monkeys to enter the breeding colonies at the right age.

Finally, the COVID-19 pandemic is a multidimensional challenge causing complex burdens and requiring a collective response. Thus, adoption of a One Health¹⁴ approach could be the best mechanism to combat COVID-19. Therefore, the monkeys should be used scientifically and rationally, abide by animal ethics, follow the 3R principles, and persist in protecting and improving the animal welfare.

2 | CONCLUSIONS

The monkey shortage will not be solved easily and will last for a long time until the COVID-19 is under control. This will have a long-term impact on monkey studies in biomedical research although the countermeasures suggested.

ACKNOWLEDGEMENTS

This article has no fund support.

CONFLICT OF INTEREST

None to declare.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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How to cite this article: Tian C-Y. China is facing serious experimental monkey shortage during the COVID-19 lockdown. *J Med Primatol*. 2021;50:225–227. <https://doi.org/10.1111/jmp.12528>