



Review Article

Advances in the Research and Application of Artificial Insemination to Equids in China: 1935–2012

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ABSTRACT

China was one of the first countries to use artificial insemination (AI) in equids, and it achieved international recognition for its widespread application of AI to commercial horse breeding. This article reviews the history of equine AI in China. The technique originated from the high demand for horses to be used in agriculture, transportation, and the military. Artificial insemination was identified as an ideal tool for Chinese horse breeding to improve the productivity of native horses, especially during 1950–1970. Presently, AI is still practiced commonly in China, and it includes the use of fresh semen and transported cooled semen. The use of frozen semen has also been resumed to broaden the range of elite Sporthorse stallions and to preserve threatened or endangered native breeds. Accurate prediction of the optimum time for insemination depended mainly on transrectal palpation of the mare's ovaries. In addition to controlled methods of insemination, factors like volume and number of spermatozoa in the inseminate and timing and frequency of insemination were optimized to accomplish high fertility rates in the field. Production of hinnies and mules for agricultural labor and donkeys for meat and hide gelatin stimulated a nationwide upsurge of research into the reproductive physiology of and AI technology in donkeys. In the future, there will be further increases in the use of traditional and modern AI techniques in the breeding of Chinese equids.

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1. Introduction

China has a 5,000-year history of domesticating two species of equids (*Equus*), the horse (*E. caballus* ["ma" in the Chinese language]) and the donkey (*E. asinus* ["lv" in the Chinese language]) [1]. During that time, considerable numbers of interspecies hybrid equids, including the mule (female horse × male donkey) and the reciprocal cross, the hinny (female donkey × male horse), have been born and

used in the northwest of China, where the first records date back to the Shang Dynasty, approximately 3,800 years ago [2,3]. During the past few hundred years, horses have played a vital role in Chinese political, economic, and military history for their importance in riding, draught, transportation, and communication. Furthermore, the horse was ranked at the top of the six traditional domestic animals in China (horse, cattle, sheep or goat, pig, dog, and chicken) [4]. Donkeys and their interspecies hybrids were also raised extensively, primarily for agriculture and transportation. However, much less scientific attention was paid to them.

Artificial insemination (AI) was identified as an ideal tool to comprehensively regulate the breeding of Chinese equids, especially during 1950–1970. In that period, China

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was the biggest country to use equine AI widely [5–7], primarily for the rapid and extensive improvement of the productivity (eg, draught and riding) of native horses [8] and to breed mules and hinnies in significant numbers for agricultural labor [4]. However, despite these extensive advances in equine AI during past decades in China, very little was known in other countries about this research and its practical application because much of the Chinese work remained unpublished or was published only in Chinese language journals [9]. The first and only insight into the situation before reform and openness of Government policy came into being was the report of the success of AI in Chinese horse breeding reported by Peilieu Cheng et al [10] in Bulgaria in 1959, which was subsequently published in Russian.

Fortunately, another similar paper was published during the Fourth International Congress on Animal Reproduction and Artificial Insemination (ICAR) in the Hague 2 years later, a summary of which was published in English in 1964 [11,12]. Further abstracts were published in association with the ICAR meetings in Madrid in 1980 and in Dublin in 1988 [13,14]. Thereafter, however, no further papers were published in English, and the focus on horse breeding declined.

The present review summarizes past Chinese literature on equine AI and describes in detail what has happened in this field during the last 77 years and speculates upon the trends that might occur in the equine industry in China in future years. The horse and donkey members of the genus *Equus* and their interspecies hybrids the mule and the hinny are also discussed.

2. Development of AI in the Equine Industry

Historically, AI in horses was first introduced into China in a paper published by Nong Lu in 1918 [15], and that was followed by a report by Bingquan Li in 1928 [16], although without any practical application of the technique. Shan-zhen Wang [17] first applied AI to horses in 1935 in the Jurong Military Stud in China's Jiangsu province. Parts of that research were included in a paper published in Chinese by Wang [17], who used the sterile sponges designed in Japan by Sato [5,7] to collect semen from Arabian stallions and inseminate it into Mongolian mares. This was followed by the increasing use of fresh stallion semen in Xinjiang, Guangxi, and Guangdong provinces. However, further research into and applications of AI were seriously hindered between 1937 and 1949 by World War II and the Civil War in quick succession, coupled with the fact that the population of equids declined by nearly one third during that same period (Table 1). It is important to mention that in 1943, during World War II, Dr. R. W. Philips, Editor-in-Chief of the *Journal of Animal Science*, was sent by the American government to work in China as a technical delegate for one year. He introduced new methods of domestic animal breeding, including AI in horses, and he donated a Colorado model artificial vagina (AV), which has been used in Guizhou province since then [7].

Horse breeding received substantial government support and was included in The National Plans in the middle of the 20th century. Soviet thinking and

Table 1
Numbers of horses and donkeys bred by AI and numbers of mules and hinnies produced in China during 1935–2010^a

Year	No. of Horses ($\times 10^6$)		No. of Horses Bred by AI at		No. of Horses Involved		No. of Donkeys ($\times 10^6$)	No. Inseminated With Donkey Semen	No. of Mules and Hinnies Produced ($\times 10^6$)
	State Studs	Private Studs	State Studs	Private Studs	AI Centers and Breeding Stations	Stallions			
1935	6.490	0	1	0	6	25	12.150	0	4.600
1949	4.875	0	5	0	450	55,000	9.494	5,000	1.471
1953	6.512	0	29	0	1,800	150,000	12.215	30,000	1.645
1959	7.058	0	45	0	3,800	600,000	9.030	150,000	1.547
1977	11.447	0	80	0	6,600	750,000	7.630	300,000	3.714
1989	10.294	15	25	15	5,500	560,000	11.136	350,000	5.391
2000	8.766	250	10	250	4,500	320,000	9.227	100,000	4.530
2010	6.771	350	8	350	3,200	250,000	6.397	120,000	2.697

^a Data from references 1, 7, 12, 13, 17, and 18. The numbers of horses, donkeys, mules, and hinnies in Chinese Taipei, Hong Kong, and Macau were not included.

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