Cloning – A Commercially Viable Reproductive Tool

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Introduction

Prior to the initial report by Wilmut describing the successful production of a cloned sheep (Dolly) by somatic cell nuclear transfer (SCNT), cloning animals from adult cell nuclei was thought to be biologically impossible.[1] Considering the history, progress that has been made in the development and application of cloning technology is astonishing. The number of somatic cell cloned animals born worldwide has increased into the hundreds. The technique has been successfully used in at least 17 different species (sheep, cattle, mice, pig, goat, deer, horse, mule, rat, domestic cat, African wild cat, dog, wolf, water buffalo, rabbit, European mouflon, and ferret).

Assisted reproductive technologies

Cloning is an emerging assisted reproductive technology that has potential to greatly enhance current agricultural practices. Assisted reproductive technologies (ARTs) have a very long history, for example artificial insemination has been employed for several hundred years, and some others (embryo transfer, IVF, embryo freezing) have been extensively used in livestock breeding for decades. SCNT does not require fertilization and therefore it allows for the propagation of proven genotypes without "genetic reshuffling".

Reproductive performance of clones

The likelihood of human consumption of meat from clones is low. Cloning will likely be utilized to reproduce elite animals for greater dissemination of their genetics and food products will be derived from their conventionally produced offspring. Therefore, it is critical to evaluate the reproductive performance of clones and growth characteristics of their offspring. Several studies indicated that cloned animals have normal reproductive characteristics.[2-8] The reproductive performance of clones including production of semen or embryos, conception rates and gestation length, were apparently normal. No difference was reported for litter size in pigs, birth weight, peri-and pre-weaning mortality between mating of clones and conventional pigs.[7-8] Furthermore, the progeny of cloned animals exhibited normal phenotypic characteristics, their growth, health and hematological parameters were comparable to normal age-matched control animals.[2-8]

Food safety

The U.S. Food and Drug Administration (FDA) is conducting a risk assessment on the safety of products from cloned animals and their offspring. The FDA Draft Risk Assessment includes agency analysis of more than 400 U.S. and international scientific studies on livestock cloning, including two reviews by the U.S. National Academy of Sciences.[9-10] The document demonstrates unequivocally there is no difference between the safety of food from cloned animals or their progeny and the safety of food from other animals (whether bred naturally or through common ARTs such as *in vitro* fertilization, artificial insemination, embryo splitting or embryo transfer) or their progeny.

Both meat and milk from animals produced by nuclear transfer have been analyzed in a number of studies and in all instances have been shown to possess a similar composition and were within the normal range for the breed.[11-19] Furthermore, a feeding trial in rats demonstrated that the consumption of meat from cloned animals had no effect on body growth, food intake, general condition, locomotor activity, reflexes, sexual cycle, urinalysis, hematology, blood biochemistry, or histology.[12, 15, 19]

Agricultural applications

Commercial applications involve employing SCNT for the expansion of elite genetics, the propagation of lost genetics and the protection of genetics in the event of a catastrophe such as foot and mouth disease. The benefit of cloning high-quality individuals will be to increase the number of descendents of elite genotypes in the breeding population via enhanced and prolonged production of a large number of offspring. Previously population outliers had insignificant impact on the mean. SCNT can amplify the impact of unique genotypes on the population. Regardless of the trait of interest (whether it's increased feed efficiency, reduce waste, disease resistance [e.g. Mastitis] or any other economic, pro-environment or animal welfare traits); cloning can offer significant genetic

improvement and rapidly increase quality and consistency of a herd. Thus, the greatest immediate impact on animal breeding may be that it reduces genetic lag.

Because of the promise of the technology many breeders have expressed strong interest in using this technology to improve the quality of their breeding stock. As with most technologies, realizing this potential has been longer and more arduous than originally anticipated. Livestock cloning today, however, has reached the stage where commercial-scale cloning is feasible and realistic.

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