Article Id
AL04245

CAN ANIMAL CLONING TECHNOLOGY BE BENEFICIAL TO INDIAN FARMERS

[1]Fanny Josan and [2]Prasanna Pal*

Email

drpalprasanna@gmail.com

[1]Animal Biotechnology Centre, ICAR-National Dairy Research Institute, Karnal, Haryana- 132001, India

[2]College of Veterinary and Animal Sciences, Kishanganj, Bihar Animal Sciences University, Bihar-855107, India

Cloning can be defined as a number of different processes used to produce genetically similar copies of a biological entity, which are termed as clones. Since February 1997, when scientists in Scotland successfully cloned a sheep they named Dolly by using DNA from an adult ewe's mammary cell, cloning earned name and fame globally. There are two types of animal cloning i.e. reproductive cloning and, therapeutic cloning. Reproductive cloning can be performed further by two methods; (i) Somatic cell nuclear transfer which is a technique in which the nucleus (DNA) of a somatic cell is transferred into an enucleated metaphase-II oocyte for the generation of a new individual, genetically identical to the somatic cell donor (Tian *et al*., 2003). The Dolly was created by using reproductive cloning. (ii) Embryo splitting involves the fusion of male and female gamete(oocyte and spermatozoa) through in-vitro fertilization (IVF) to form a zygote. After the successful fusion of both the gametes the cell division follows which is termed as cleavage, in order to develop the zygote into an embryo. This zygote divides into two and further four genetically identical cells which can further be split into separate cell to develop individual blastocyst from each split cell from the same embryo. These fully developed blastocysts can be implanted into the uterus of mature females. Therapeutic cloning on the other hand is an another form of SCNT involving the transfer of nuclear material isolated from a somatic cell into an enucleated oocyte in the goal of deriving embryonic cell lines with the same genome as the nuclear donor (Kfoury *et al*., 2007). These cells can be cultured for in an indefinite period of time for further production of organs as well as the tissues that are accepted by the immune system of the patients**.**

Benefits of Animal Cloning Technology

Some of the advantages of Animal cloning technology are discussed below**:**

(i) It helps in multiplication of elite animals by producing their genetically identical copies. These elite animals can be the high milk yielder female or high fertility potential bulls with best semen quality parameters (Smith *et al*., 2000).

(ii) Animal cloning has a vast application in preserving the endangered species all over the globe. Some of the examples includes; successful preservation of Enderby Island cattle breedof New Zealand using the method of adult somatic cell nuclear transfer (SCNT) (Smith*et al*., 2000). Another example includes production of a clone of the only wild-buffalo in Chhattisgarh, India, through the 'Hand-guided Cloning Technique' at ICAR-National Dairy Research Institute, Karnal. The female calf named **'Deepasha'** was born on December, 12, 2014 (NDRI, Karnal, icar.org.in).

(iii) This technology along-with the Transgenesis, has helped in transgenic animal production which is a process of incorporation of foreign DNA into cellular genome. The first transgenic mammals were created by microinjecting gene constructs into the zygotes of fertilized mice (Brinster *et al*., 1985). A number of animals like Sheep and Cattle have been produced by using transfected cells and nuclear transfer technology (Cibelli *et al*., 1998).

(iv)Production of transgenic animals for the purpose of xeno-transplantation through nuclear transfer cloning is another great milestone led by animal cloning technology. Pigs have been chosen as study animals for xeno-transplantation research because of their physiological similarities to humans and lesser cost when compared to other primates (Piederahita*et al*., 2004). Production of Xeno-transplants by using cloning technology will help production of organs from immunogen triggering protein gene knockout pigs leading to reduced hyper-immune response in the recipient humans.

Shortcomings of Animal Cloning Technology

(i) Although the nuclear transfer method is more effective at producing transgenic domestic animals, the cloning method does not address the issue of random insertion and its related positional effect (Piederahita *et al*., 2004).

(ii)The percentage of early abortions is very high in case on cloned embryos.

(iii)Cloned animals shows a prevalence of respiratory distress syndromes which may be a sign of inadequate adrenal gland growth and function, low foetal cortisol levels, and consequently, insufficient lung surfactant (Hill *et al*., 1999).

(iv)The ratio of surviving offspring to transplanted embryos in cattle and pigs is very low i.e. about 6-15% and 6%, respectively (European Food Safety Authority. (2012) which is still more or less same.

(v) The chances of early as well as late pregnancy losses are more in cloned embryos transfer. In case of cattle, the early loss is found to be due to unsuccessful placenta formation and the late ones are because of reduction in placentome with an increase in placentome weight (Hill *et al*., 2000; Heyman *et al*., 2002; Hoffert *et al*., 2005; Kohan-Ghadr *et al*., 2008).

(vi) The animals with cloned embryo transfer face the problem of hydroallantois during the pregnancy period which further might induce perinatal mortality. (Heyman *et al*., 2002; Schmidt, 2007; Schmidt *et al*., 2010; Schmidt *et al*., 2011; Chavatte-Palmer *et al*., 2012).

(vii) The offspring born through the cloning technology are mostly bigger in size as compared to naturally conceived ones which increases the occurance of Dystocia, defined as a difficult calving due to prolonged parturition or severe assisted parturition

(viii) Because the cells have a very limited capacity for development so the animal cloning by embryo splitting method makes the process non-repeatable leading to production of only two identical mice/animals at a time.

Conclusions

Animal cloning has immense economic and societal potential, however, before this technology is widely used, several issues related to the generation of cloned animals must be properly examined through appropriate research. To increase this genetic diversity, it can recreate reproductively competent copies of animals that had perhaps been incompetent or made incompetent early in life. The genetic diversity in one way can be increased by cloning the rare, endangered breeds or species of animals, but the expanses of animal cloning are so high that it can be restricted only to the high yielders or elite animals which in turn will decrease the genetic diversity or genetic variation.

References

Brinster, R. L., Chen, H. Y., Trumbauer, M. E., Yagle, M. K., &Palmiter, R. D. (1985). Factors affecting the efficiency of introducing foreign DNA into mice by microinjecting eggs. *Proceedings of the National Academy of Sciences, 82(13),* 4438-4442.

Chavatte-Palmer, P., Camous, S., Jammes, H., Le Cleac'h, N., Guillomot, M., & Lee, R. S. F. (2012). Placental perturbations induce the developmental abnormalities often observed in bovine somatic cell nuclear transfer. *Placenta, 33*, S99-S104.

Cibelli, J. B., Stice, S. L., Golueke, P. J., Kane, J. J., Jerry, J., Blackwell, C., ... &Robl, J. M. (1998). Cloned transgenic calves produced from nonquiescent fetal fibroblasts. *Science, 280(5367),* 1256-1258.

European Food Safety Authority. (2012). Update on the state of play of Animal Health and Welfare and Environmental Impact of Animals derived from SCNT Cloning and their Offspring, and Food Safety of Products Obtained from those Animals. *EFSA Journal, 10(7),* 2794.

Heyman, Y., Chavatte-Palmer, P., LeBourhis, D., Camous, S., Vignon, X., &Renard, J. P. (2002). Frequency and occurrence of late-gestation losses from cattle cloned embryos. *Biology of reproduction, 66(1),* 6-13.

Hill, J. R., Roussel, A. J., Cibelli, J. B., Edwards, J. F., Hooper, N. L., Miller, M. W., ... &Stice, S. L. (1999). Clinical and pathologic features of cloned transgenic calves and fetuses (13 case studies). *Theriogenology, 51(8),* 1451-1465.

Hill, J. R., Burghardt, R. C., Jones, K., Long, C. R., Looney, C. R., Shin, T., ... &Westhusin, M. E. (2000). Evidence for placental abnormality as the major cause of mortality in first-trimester somatic cell cloned bovine fetuses. *Biology of reproduction, 63(6),* 1787-1794.

Hoffert, K. A., Batchelder, C. A., Bertolini, M., Moyer, A. L., Famula, T. R., Anderson, D. L., & Anderson, G. B. (2005). Measures of maternal-fetal interaction in day-30 bovine pregnancies derived from nuclear transfer. *Cloning and stem cells, 7(4*), 289-305.

Kfoury, C. (2007). Therapeutic cloning: promises and issues. *McGill Journal of Medicine: MJM, 10(2)*, 112.

Kohan-Ghadr, H. R., Lefebvre, R. C., Fecteau, G., Smith, L. C., Murphy, B. D., Junior, J. S., ... &Hélie, P. (2008). Ultrasonographic and histological characterization of the placenta of somatic nuclear transfer-derived pregnancies in dairy cattle. *Theriogenology*, *69*(2), 218-230.

Piederahita, J. A., & Mir, B. (2004). Cloning and Transgenesis in mammals: Implications for xenotransplantation. *American Journal of Transplantation*, *4*, 43-50.

Schmidt, M. (2007). Perinatal death associated with ET, IVP and cloning in cattle. *ActaVeterinariaScandinavica*, *49*(1), 1-3.

Schmidt, M., Winter, K. D., Dantzer, V., Li, J., Kragh, P. M., Du, Y., ... &Agerholm, J. S. (2011). Maternal endometrial oedema may increase perinatal mortality of cloned and transgenic piglets. *Reproduction, Fertility and Development*, *23*(5), 645-653.

Smith, L. C., Bordignon, V., Babkine, M., Fecteau, G., & Keefer, C. (2000). Benefits and problems with cloning animals. *The Canadian Veterinary Journal*, *41*(12), 919.

Tian, X. C., Kubota, C., Enright, B., & Yang, X. (2003). Cloning animals by somatic cell nuclear transfer–biological factors. *Reproductive Biology and Endocrinology*, *1*(1), 1-7.