

CORRESPONDENCE

Development of cloning technology for humans

'Hello Dolly' by K. P. Gopinathan (*Curr. Sci.*, 1997, **72**, 362–364) presents an excellent summary of the achievements made by Wilmut's group at the Roslin Institute, in animal cloning and briefly discusses the ethical, social and philosophical issues that have been raised in extending the technology to humans. The cloning technology would certainly have immense advantages over the methods currently used in animal breeding. Artificial insemination (AI) from semen collected from identified, superior bulls is widely used for genetic improvement of cattle. AI however, limits the benefits of the desirable genes only from the male side which contributes half of the offspring's genome. Superovulation and transfer of embryos to surrogate mothers – the embryo transfer technology (ETT), enables selection of both male and female genetic contribution. Yet, the genetic potential of the offspring remains a matter of chance, dependent upon random segregation of the genes. Cloning would provide for selective multiplication of the proven, elite combination of genes by choice. The technique, as reported by Wilmut *et al.* (*Nature*, 1997, **385**, 810–813), however, needs further research inputs and refinement to realize high success rate, minimize induction of genetic alterations in the process and for cost effectiveness. Therefore, animal cloning research should receive increased support. Considering the potential advantage of the technique in animal breeding, private funds will be channelled to develop commercially viable cloning technologies as has happened in plants. It is estimated that current global production of *in-vitro* raised plants is around 750 million and increasing rapidly.

As mentioned by Gopinathan, and widely reported in media, extending of the cloning technology to humans has

received a negative response in the US, France, Germany, Japan and from Vatican, which is not unusual for any new technology dealing with life processes, especially the human life. Therefore, ethical, social and philosophical questions need to be examined by the biologists, social scientists, decision makers and public after careful considerations of the facts. The new technologies, especially the biological one, are often misconceived by the people. The general misconception about cloning is that the clones would be the 'photostat copy' of the donor. This is far from truth. The phenotype – size, shape, appearance, behaviour, ability to acquire skills, etc. – is dependent on the genotype (the genetic content), environment and interaction of the genotype and environment during all developmental phases. The clone will have its origin from a single cell, modified to develop and grow like an embryo, and implanted in a surrogate mother. It would undergo development in the womb, just like the embryo following normal reproductive process, to be delivered after the completion of the gestation period. Women will have an added advantage that they can use their own womb to raise their clone. The only difference between the clone and the naturally conceived child would be in the genetic makeup. After birth, the clone will have to pass through different development stages, learn to talk, walk, acquire language, education and other skills. Depending upon the age at which the cloning decision is made, there will be a large age difference, and hence, the generation gap, between the parent and the clone in knowledge, social and technical skills.

Who would like to have their clones? Many new reproductive technologies such as artificial insemination, *in vitro* fertilization and embryo transfer have

been available for many years now. They have been largely used by people unable to have a child through normal reproductive process, and have brought immense joy, happiness and emotional satisfaction to thousands of families. One may argue about why such technologies are needed in an overcrowded world struggling to limit the population growth. They are also expensive, and only rich families can afford them which for the overall benefit of the society should go for adoption from orphanages. Motivations to have a clone could be emotional, medical, emotional-cum-medical, ego satisfaction or a demand from a section of the population to have clones of their favourite leaders, musicians, creative artists, writers, sportsman, 'gurus' and even scientists with brilliant minds like Einstein. Considering the age difference and generation gap between the parent and the clone, discussed earlier, rapid changes in people's tastes, values and fads in highly technology-driven society, it is doubtful, if ever, the clones will have the same advantages in a different period. It is unlikely that many would rush to the cloning clinics, even if they can afford the cost. Variety is the spice of life and well-being of the society depends on the available biological and cultural diversity. Therefore, cloning would neither be widely accepted nor would it be beneficial for the well-being of *Homo sapiens*. At the same time, it is likely that the people who resort to *in vitro* fertilization from the unknown donor sperms, obtained from the sperm bank, may prefer to have a clone of one of the parents, instead of using donor sperm. When both the parents are unable to produce children due to various reasons, cloning perhaps, would be the chosen alternative.

With the growing population, one child

per family is likely to be the norm in future, and couples for emotional security may like to have cells of their child preserved in liquid nitrogen, as a 'backup' to be used for cloning in the event of untimely death. If the child suffers from leukaemia and needs regular bone marrow transplant, the best source would be the clone, also for organ transplant. Parents having a child with genetic disorder such as Duchenne muscular dystrophy (DMD) would be extremely happy to have a clone of their child in which the genetic disorder was corrected before embryo implantation. This may be possible one day as selective implantation is possible at present. Only the families having a child with such genetic disorder can appreciate the joy of having a 'normal' version of their loved one. Similarly, it may be possible to obtain a virus-free clone of a child accidentally infected with AIDS virus. These, however, will raise perplexing moral and emotional issues.

Misuse of the technology to produce one or more clones of a dictator, potentate or CEO of a large corporation certainly cannot be ruled out if the technology is

available. However, this possibility should be considered on the basis of the misuse of the already available reproductive technologies. How many of the dictators or the 'gurus' with unquestioned blind following have used artificial insemination to perpetuate their genes?

Ethical issues are certainly the most difficult as the moral values differ in different societies and individuals within the society. The most common objection often raised by the religious leaders is that humans should not interfere in God's creation. Such views are irrelevant, like many other stands of the religious leaders, for example, on population control in the present society. Civilization has developed by modifying nature or as the believers would say 'God's own creations', to satisfy its needs in all aspects of life. We enhance natural immunity by vaccination, get rid of infections by antibiotics, remove or replace damaged organs by surgery to prolong the life span, and at the same time use different means to control population. All these are human interferences with nature or God's creation. Without such modifica-

tions of nature and natural processes, the modern society cannot maintain its current life style. Should there be limits set on the development of technologies that may, in future, improve the quality of life? We will go only this far, but not beyond. The development of the cloning technology should not be banned just because of the fear that it may be misused by some. All technologies can be misused and that should not be the reason to prohibit their development and use. Legal means to prevent misuse should be applied. Cloning technology, as outlined earlier, may in future bring enormous emotional satisfaction to a section of the society. At the same time, as in the human genome research, certain percentage of funds should be used to understand, ethical, legal and social implications of the technology.

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Hello Dolly

Dolly's emergence (*Curr. Sci.*, 1997, **72**, 362-364) has raised too many unwanted ethical questions rather than appreciating many things that it has exposed. First, the myth of the 'one way clock' in animal cell differentiation has been debunked and this has brought cheer to those trying to control or reverse uncontrolled cell proliferation. In food and agriculture, abundance of identical animal meat may not be possible but abundance of milk is predicted. Emergence of a world free

of sex and sex-related crime is bound to make it a safer place for the females. While cloning men to yield identical duplicates may have problems because of the need for and variation in surrogate mothers, the emergence of 'do-it-yourself' technology to generate identical women appears to be in the offing. In other words, cloning Hitlers, Amins or Sukh Rams may be difficult but cloning Jayalalithas, Shiela Kauls, the Bandit queens and the like, appears a

strong possibility. Let us therefore not worry about the custom made soul but worry about the emergence of a society full of clones of the above types.

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