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Reproductive Biotechnology in farm animals: Artificial Insemination (AI), In-vitro embryo production and Cloning

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The production and reproduction are crucial trait for profitable dairy industries. There is no production without reproduction. In today's era many advancement has been made in the field of reproductive physiology, even though, infertility due to low conception rate and high embryonic mortality rate remains a major issue. To meet future needs and to be able to sustain production, research in the reproduction and its applications is a needs. Reproductive biotechnology in farm animals is techniques using biological systems and organisms to improve reproduction in animals and humans, aiming to enhance fertility, breeding efficiency, and genetic diversity. It includes methods like Artificial Insemination (AI), In-vitro fertilization (IVF), Cloning and many more.

Artificial Insemination (AI)

AI is process of collection semen from genetically superior bulls in sterile receptacle, evaluation, processing, preparation of straw, freezing (-196 degree Celsius) and inseminating the female in ideal time during estrus at proper place of female genital tract.

This technology has now become a practical technology in commercial dairy cattle programs in both developed and developmental countries. In present scenario a large number of AIs are performed globally. Moreover, after 6-7 decades, the conception rate field AI programmes in developing countries is very low, and therefore the desired effect in terms of animal improvement has not been achieved. The reasons behind are lack of proper management and technical skill. AI will become more effective only when farmers will have access to considerably better technical and well organise infrastructure.

In-vitro fertilization (IVF)

As the term 'in vitro fertilization' explains itself, it is the procedure to fertilize eggs with sperm outside the body. IVF or In Vitro Fertilization is a method of assisted reproduction to increase the possibility of pregnancy. It includes the step like: collection of oocyte by different methods like

aspiration, slicing from slaughter animals. Ovum pick up by transvaginal ultrasonography guide and laparoscopy. Immediately after retrieval of oocytes, maturation of oocytes, fertilization, culturing of oocytes and production of embryo and freezing of embryo and as per the requirement transfer of embryo in female animals.

Inspite of continuous efforts to improve bovine in vitro embryo production (IVP), its efficiency is still low since only 30 to 40% blastocyst development has been obtained from oocytes after in vitro maturation fertilization and embryo culture. In vitro production technologies not only help in production of high genetic merit animals, but also provide an excellent source of embryos for emerging biotechnologies like embryo sexing, cloning, nuclear transfer, transgenesis etc. Furthermore, it allows analysing developmental potential of embryos.

Semen sexing:

Semen having X or Y bearing sperm to produce progenies of a desired sex either female or male (with about 80-90% accuracy) is known as sexed semen. Sex sorting technology was developed by the USDA (United States Department of Agriculture) researchers in Livermore, California, and Beltsville, Maryland. The technology was patented as "Beltsville Sperm sexing technology". The commercialization of sexed semen started in United States in 2001 with a license granted to Sexing Technologies (ST), Texas. At present, ST commercially produces sex sorted semen in many countries of Europe, USA, Canada, Mexico, Brazil, China, Japan etc.

Sperm are sorted by identifying differences between the X- and Y- bearing sperm. The X-chromosome (female) contains about 3.8% more DNA than the Y-chromosome (male) in cattle. This difference in DNA content is used to sort the X- from the Y- bearing sperm.

Considering the high fertility rate of the heifers, it is recommended that sexed semen should be used only in heifers (especially virgin heifers) for better conception rate. However, it can also be used in cows up to third lactation with excellent reproduction record

Cloning

It is the processes used to create an exact genetic replicat of another cell, tissue or organism. The copied material, which has the same genetic makeup as the original, is referred to as a clone. The most famous clone was a Scottish sheep named Dolly.

It is a powerful technique and potentially it could be used for multiplication of elite animals and minimize the genetic variation in experimental animals. It can be used for the conservation as well as propagation of endangered species. It may be used as a tool for the production of stem cells for therapeutic purposes, as therapeutic cloning. Cloning using somatic cells offers opportunities to select and multiply animals of specific merits

In regards to the status of cloning technique, a survey conducted in 2005 by the OIE in which 91 countries participated (60 percent from developing countries), 4 percent of the respondents in Africa and 23 percent of the respondents in Asia, reported having cloning capabilities. Recently in the list of cloned animal, first cloned camel, "Injaz", a female, (2009) and second cloned camel, Bin Soughan, a male, (2010) were born at the Camel Reproduction Center in Dubai, United Arab Emirates. Through introducing a new technique "Hand guided Cloning Technique" world's first buffalo

calf GARIMA-I (2009) was born at NDRI Karnal (India). Later on by utilizing same technique GARIMA-II (2009), and a male buffalo calf, Shresth (2010) have been produced in same institute.

Conclusion: Adopting assisted reproductive technology in breeding programme is playing crucial role to increase the milk and meat production to meet the demand of world increasing human population.