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Popular Article

In vitro fertilization

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Abstract

The process of creating embryos by fertilizing mature oocytes with sperm outside the female reproductive tract is described as in vitro fertilization. In this, oocytes are collected for donor of superior genetic merit and fertilized outside the female reproductive tract (in a dish), supplemented with all essential agents to support fertilization process. Finally, embryos are produced, cultured and transferred to recipient of average genetic merit. The overall aim of this technique is to disseminate the genetic potential of elite donor female, efficient use of female of average genetic merit and to overcome the infertility problems. This article briefly addresses the applications, procedure, and benefits of in vitro fertilization in production animals.

Introduction

In Latin in vitro means "in glass" and in vitro fertilization (IVF) is frequently used as a general term for the process of generating embryos outside the body. First report on the birth of rabbit was after IVF was published on 1959 [1] followed by hamster in 1963 and mouse in 1969 [2]. In the domestic species, the first calves produced after IVM and IVF were reported on 1987 [3]. It is emphasized that in vitro embryo production (IVP) is most widely used in cattle and that IVP embryos are much more fragile than those produced in vivo. Two main applications of IVF technology are; commercial and research applications. By commercial applications of IVF we mean that we can get the offspring from infertile cattle or pregnant cattle or young heifers prior to breeding age**,** efficient use of sexed semen and resorted semen is possible and we can efficiently utilization slaughterhouse-derived oocytes for in vitro fertilization. Improvement of IVF technology and Improvement of in vitro culture (IVC) for cloning and transgenic procedures are some of the research applications of IVF.

In vitro embryo production consists of three distinct phases; in vitro maturation (IVM) of oocytes, in vitro fertilization (IVF) of oocytes with spermatozoa, and in vitro culture (IVC) of presumptive zygotes.

An oocyte that is considered competent for IVP is referred to as "matured". IVM of immature oocytes occurs by different mechanisms from that of in vitro matured oocytes. Removal of an oocyte from the inhibitory follicular environment followed by favorable culture conditions results in spontaneous maturation without the physiological series of events that occur in vivo, though some morphological changes can be observed. In vitro conditions simulate some of the physiological changes with the addition of hormones, including LH, FSH, and estradiol-17ß, which are typical of the preovulatory follicle, and growth hormones or epidermal growth factor. Majority of these oocytes can achieve maturation during a 24 hour period of IVM. Once in vitro maturation (IVM) is complete, oocytes are ready to be fertilized. This involves the coincubation of oocytes with spermatozoa and is generally done in a 4-well dish, and can also be done in a micro drop under oil. Most laboratories allow for 18 hours of coincubation, even though the majority of fertilization events will be complete by 12 hours of coincubation. On ejaculation, spermatozoa are motile but not capable of fertilizing an oocyte. The changes that spermatozoa undergo before it is capable of fertilizing an oocyte are collectively called capacitation. The challenge for those performing IVF is to provide the spermatozoa with an environment that supports capacitation. Temperature is a critical factor for successful capacitation. Like in case of sheep and pigs capacitation is efficient at body temperature. While as, in cattle, capacitation at 38.5˚C is most favorable, including for the fertilization process. Tyrode's and Krebs-Ringer solutions supplemented with an energy source like glucose, lactate, and pyruvate and albumin support the capacitation process. The primary capacitation agent added to fertilization media is heparin. After in vitro fertilization of oocyte, embryos are produced, which are subjected to evaluation to get good quality embryo and then transferred to the recipient for further development.

Main advantages offered by this technique include improvement of fertility in donor females of average genetic merit, exploitation of genetic traits of superior female, efficient use of sexed semen thereby increasing the chances of obtaining desired sex of offspring, generation of higher number of embryos, which in turn results in more number of pregnancies per unit time. In vitro fertilization technique also made it possible to detect genetic abnormalities or chromosomal disorders before the actual transfer of embryo.

Conclusion

In order to overcome the reproductive failure and to enhance the genetic progress in production animals, the choice is to go for selection of animal of high genetic merit and by increasing the number of offspring from the animals which are infertile or not able to produce or having some reproductive abnormality, by means of in vitro fertilization technique. In vitro fertilization has

proven successful in the commercial field, thereby permitting practitioners and cattle producers to improve reproductive performance, efficiency and genetic gain.

References

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