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Relevance and Technological Implications of *in Vitro* Fertilization in Animal Breeding and Reproduction: A Review

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***Abstract*-- In vitro fertilization (IVF) is a process by which retrieval oocytes fertilized by sperm outside the body (in vitro). IVF is a major treatment in infertility. This technique has become a routine procedure and widely been used in treating infertile human all over the world. In animals, IVF has offered a very valuable tool to study mammalian fertilization and early embryo development .The IVF technique tagged with ovum pick up can be used for infertile, aged and diseased animals to produce progeny in the organized sector and livestock development.**

***Keywords*-- Animal breeding, IVF, Reproduction**

I. INTRODUCTION

In vitro fertilization (IVF) refers to fertilization of the oocyte outside of the body. Work on *in vitro fertilization* began as early as the 1930 with rabbit oocytes, these first attempts at *in vitro fertilization* were not successful, subsequent research in the late 1950 led to the birth of rabbit pups produced using oocytes fertilized *in vitro*. In the early days, embryos were usually produced using *in vivo*-matured oocytes and after IVF, zygotes were transiently *in vivo*-cultured into the oviducts of surrogate females before the embryo transfer. Cheng et al. (1986) reported the first successful IVF in piglets. Only two foals have been produced by conventional IVF, both resulting from insemination of an oocyte matured in vivo (Palmer *et al*., 1991; Bezard *et al*., 1992). Hamner et al., (1970) reported successful IVF in cats. First bovine offspring from IVF was a bull calf born in 1981 (Brackett *et al.,* 1982) India became the first country to produce the first IVF buffalo calf as early as in 1991(Madan *et al.,* 1991). Thibault *et al.* (1954) reported that sperm capacitation was an essential prerequisite to fertilization of rabbit ova *in vitro*.

Procedure used for in vitro fertilization

The *IVF* procedures for bovine embryos consists of three steps. first, *in vitro* maturation (IVM) of primary, germinal vesicle-stage oocytes collected directly from the ovaries of donor females, second, IVF by combining *in vitro* matured oocytes with *in vitro* capacitated sperm cells and third, *in vitro* culture (IVC) of presumptive zygotes to stages of development that allow them to be transferred to female recipients.

Advantages of in vitro fertilization

IVF has also been used to produce thousands of embryos needed for scientific research. Oocyte maturation could also provide material for cloning by nuclear transplantation and for making transgenic animals. Among domestic species, greatest progress in developing IVF and complementing technology because of emphasis on bovine reproduction (Brackett, 1998). For IVF in cattle, the percentage of live offspring per transferred embryo is 45-60% (Chavatte-Palmer *et al.,* 2012). These embryo transfers provide a complete set of new genes and greater genetic gains over that obtained with artificial insemination, where only the paternal half of the genome can be introduced. Supplying embryos from slaughter house oocytes for twinning programmes to increase calves without increasing the number of cows. Embryo transportation is also considerably easier than live animal transportation. The chances for disease transmission are greatly reduced when compared to whole animal or semen introductions. Properly handled embryos have transmitted no known disease, thus increasing its survivability as well. With IVF, genetic material from dead animals can be utilized. Obtain more offspring from valuable females. If valuable females get old oocytes can be retrieved and offspring produced from them.

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Repeated oocyte recoveries can be performed on live donors, allowing several offspring to be produced per year from a single female. Thus, a valuable female can contribute greatly to the next generation. The IVF procedures can effectively replace conventional in vivo embryo production methods when numbers of pregnancies of known sex are needed within a short interval of time (Bousquet *et al.,* 1999*).* Bovine IVF provides a means to decrease the generation interval (Armstrong *et al.,* 1997), to produce calves via sexed semen *(*Cran *et al.,* 1993*),* to overcome infertility and to expand reproductive potential and reproductive life of pregnant animals (Ryan *et al.,* 1990*),* propagation of endangered cattle breeds (Solti *et al.,* 1992*),* to produce large numbers of half-siblings simultaneously, to extend valuable semen via sperm injection (*Goto et al.,* 1990*),* to assess gamete performance, to provide pronuclear ova for DNA microinjection *(*Krimpenfort *et al.,* 1991*),* Cytoplasmic transfer, nuclear transfer *(*Strice *et al.,* 1998*),* cloning by blastomeric recycling *(*Trounson *et al.,* 1998*),* conservation of endangered mammalian species (Bainbridge *et al.,* 1998), to produce offspring in the Indian desert cat (Pope *et al*., 1989*),* Siberian tiger (Donoghue *et al*., 1990*)* as well as several species of non-human primates. IVF may be used as a tool to evaluate male fertility (Papadopoulos *et al*., 2005), to evaluate ejaculate fertility of rare species males (Comizzoli *et al*., 2001) and production of many fertilized embryos (Motli and Fulka, 1974).

Comparison of in vitro fertilization with conventional method

IVF emerged as an alternative to super ovulation and has become the technique of choice for bovine embryo production, especially in zebu breeds (Viana *et al*., 2012). In Nelore cows it was possible to produce more embryos and pregnancies compared to conventional Multiple Ovulation Embryo Transfer (Pontes *et al*., 2009), extend reproductive life of cows that do not respond to super ovulation treatment or produce only unfertilized ova. The number of pregnancies can be four times higher within 50 days than by using the conventional approach (Bousquet *et al.,* 1999). Leitch *et al.* (1995) found that the annual genetic progress was 10 to 30% superior to conventional Embryo Transfer, chiefly because IVF offers greater flexibility in mating of sires to the different cow, thus reducing inbreeding. IVF technology allows the use of several bulls with one donor, since the control of fertilization is made *in vitro* as opposed to conventional ET which is limited to one bull per session. IVF can be applied during different stages of reproduction, including the prepubertal period and during the first 3 month of pregnancy.

With the utilization of prepubertal heifers, it is possible to decrease the age of the donor female, thereby contributing to a decreased generation interval. IVF technology provides excellent and cheap source of embryos for carrying out basic research on developmental physiology, animal breeding cloning and transgenic livestock production (Nandi *et al*., 2006).

Disadvantages of in vitro fertilization

The main problem is the cost. IVF requires skilled labour, a controlled laboratory environment and expensive equipment. Fertilization and pregnancy rates are not as high as with natural mating or artificial insemination. Embryos that have been frozen have even lowered survivability, Poor recovery of oocytes per ovary is another major constraint in IVF protocols, Low rate of fertilization appears to be related to the inability of spermatozoa to penetrate the equine zona pellucida in vitro, as fertilization rates are greatly improved by partial removal of the zona pellucida (Choi *et al*., 1994).

Media used for In vitro fertilization

For *in vitro fertilization* to occur, the media used must be capable of supplying the sperm cells with nutrients and chemical signals to enhance sperm motility and induction of capacitation to facilitate the fusion of the gametes and the beginning of embryonic development. With *in vitro fertilization* (IVF) unfertilized eggs (oocytes) removed from the donor cow's ovaries. The oocytes mature in an incubator and are fertilized with sperm. The resulting zygotes incubate and develop in the laboratory before being placed into the recipient cow.

II. Conclusion

IVF technologies better than conventional embryo transfer method in many ways. The progress in IVF, by the ability to achieve gamete union and pregnancies following embryo transfer in common laboratory and domestic animals. The conditions available for support of oocyte maturation, sperm capacitation, IVF and embryo culture for several species need to be improved significantly so as to obtain transferable embryos to enhance reproductive efficiency in laboratory, domestic and zoo animals.

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