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Parthenogenesis between reality and truth

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Abstract

Meiosis and mitosis are the two most crucial processes that eukaryotes use to create their genomes during sexual reproduction. Meiosis and mitosis differ in a number of ways, including: Meiosis I involves the rearrangement of chromosomes with homologous centromeres, known as reduction division, and Meiosis II involves the segregation of sister centromeres (equational division) (Meyer et al. 2010). Initially, meiosis is defined as a single round of DNA replication, followed by two main processes. Parthenogenesis in mammalian cells was initially reported in 2006, when the cells were assessed for pluri potency and differentiation plasticity in vitro and in vivo (Pennarossa et al., 2011). The process of developing embryos from unfertilized oocytes is known as "in vitro parthenogenesis," and it can be induced in a number of animals, including mammals. The prospective uses of this approach in stem cell research, reproductive biology, and agricultural developments have drawn interest. Certain triggers, including raising cytoplasmic free calcium levels, can cause parthenogenesis in mammalian oocytes (Kharche & Birade, 2013). There are several activation techniques, but because the process is specific to each species, they must be customized (Kharche & Birade, 2013). Cloning, somatic cell nuclear transfer, and the production of pluripotent stem cell lines—all essential for tissue engineering—can be accomplished with activated oocytes (Kharche & Birade, 2013).

Using embryonic stem cells for germ cell production, in vitro gametogenesis is being investigated in livestock to improve genetic qualities (Goszczynski et al., 2023). There are ethical questions surrounding the use of in vitro parthenogenesis, especially in light of its possible abuse in reproductive technology (Pugeda, 2024). Although in vitro parthenogenesis offers fascinating prospects for scientific progress, it also requires close ethical examination to avoid possible abuse in reproductive settings.

In parthenogenesis, the female produces an offspring without the requirement for paternal inheritance, and the spermatozoa do not need to fertilize the oocyte (Schickl et al., 2017). In mammals, parthenogenesis was not a natural process.However, stimulation of mammalian oocytes parthenogenetically results in early embryonic development by artificial manipulation and in some situations can be achievedfetal early development (Bos-Mikich et al.,2016) ; (phylaKatoh et al., 2017)

I. Methods of Parthenogenesis in mammalians:

There have been numerous attempts to describe parthenogenesis in mammals, particularly in humans and domestic animals. The following is a summary of the most significant practical method for parthenogenesis in mammals:

Pig embryos derived from in vivo (IVV) embryonic vesicles (GV), MII, 2-cell (2C), 4-cell (4C), 8-cell (8C), morula (M), early blastocyst (EB), expanded blastocyst (XB), hatched blastocyst (HB), and embryonic day 11 (D11) HB (hatched blastocyst before elongation) stage were extracted from gilts and stored separately. The day 0 (D0) is the day of artificial insemination. Following collection, all embryo samples were put on dry ice and kept at 280 °C until the RNA was extracted (Zhou et al., 2014). Artificial activation is used to achieve parthenogenesis in vitro without the need of sperm. One useful functional indicator of oocyte developmental competence is parthenogenesis, which can be stimulated in vitro by a variety of electric, mechanical, or chemical stimuli. (McElroy et al.,2010). When compared to

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traditional techniques, parthenogenetic activation-induced pluripotent stem cells (paiPS) produced from parthenogenetic embryos exhibit potential for treating degenerative disorders with less ethical issues (Yin et al., 2012). Cumulus-free human oocytes are matured in vitro using culture conditions supplemented with ovarian paracrine/autocrine growth agents chosen based on the gene expression profiles of individual human oocytes and related cumulus cells. The capacity of the oocytes to develop to the blastocyst stage and the gene expression patterns of parthenogenic and IVF/ICSI embryos were then used to test the functionality of the in vitro-matured oocytes. (McElroy et al.,2010).

Using an ECM 2001 stimulator (BTX, Holliston, Massachusetts), two sets of electrical stimulation were administered 30 minutes apart to activate meiosis II oocytes. For every set, the oocytes were placed in a solution that contained 0.3 M mannitol in water with 0.1 mM CaCl2, 0.1 mM MgCl2, 10 mM HEPES, and 0.1% poly-vinyl alcohol (PVA). Three direct current (DC) pulses of 1.2 kV/cm were administered for 60 µsec each. Electrically stimulated oocytes were then cultured in a 500 µl drop of KSOM medium under mineral oil in a 37°C, 5% CO2 environment after being incubated for two hours at 37 °C in Potassium Simply Optimized Medium (KSOM – Specialty Media, Phillipsburg, New Jersey) containing 5 µg/ml cyclohexamide (CHX) and 1 mM 6-Dmethyl aminopyridine (DMAP). Generally speaking, DMAP acts as a catalyst for acylation processes, while CHX keeps the cell cycle in interphase (Koh et al., 2009).

II. Parthenogenesis in farm animals :

Parthenogenesis can be experimentally induced in a number of animals, including goats, where embryos have been produced in vitro (Ranjan et al., 2015). Even though parthenogenetic embryos can be created, the absence of paternal DNA commonly results in viable births in certain animals, such as goats (Ranjan et al., 2015). Parthenogenetic embryos' capacity to produce haploid embryonic stem cells could have implications for cloning and domestic animal genetic studies (Singh et al., 2019). Research on parthenogenesis's potential to increase livestock reproductive efficiency is still ongoing with the aim of overcoming current limits (Ranjan et al., 2015). Due of parthenogenetic activation's relatively low success rates, it is particularly challenging to use in farm animal reproduction. (Singh et al., 2019). One major obstacle to parthenogenetic embryos' survival is the lack of paternal genetic contributions, which restricts their potential to produce living offspring (Ranjan et al., 2015).
It improves survival in remote areas by enabling reproduction without males in species like the king cobra (Card et al., 2021). Genetic variety can be preserved in parthenogenetic progeny, which is essential for adaptation and evolution in shifting environments (Card et al., 2021). An ethical substitute for conventional sources of embryonic stem cells is provided by parthenogenetic embryos, which can produce haploid embryonic stem cells (Singh et al., 2019); (Pennarossa et al., 2011). Parthenogenesis, which helps organisms colonize harsh or newly available environments, is frequently associated with polyploidy. (Gassner et al., 2014).
In conclusion of this , we can say that parthenogenesis could be implicate in now in some kind of animals species in-vitro and in future it may become the main procedure for reproduction specially in endangered animals and even human .

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