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Perspective

Development of Common Carp Donor Progeny using Goldfish as Surrogate Spawn Stock

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DESCRIPTION

The fourth most widely cultivated fish species is the common carp (*Cyprinus carpio*), which is primarily grown in Europe and Asia. So much effort has been put into developing breeding programmes and raising common carp's performance in aquaculture. Since their F1 hybrids are employed in aquaculture, breeding projects are also supported by initiatives to develop techniques for the preservation of current purebreds. The special genetic resources of the parental breeds are safeguarded with the appropriate safeguards. The majority of common carp broodstock is kept in live gene banks. Breeds, however, may be at risk from genetic tainting, genetic variability loss, or unforeseen environmental/technical mishaps. Cryopreservation management is therefore used to protect the paternal portion of living gene banks. Unfortunately, mature fish oocytes cannot be cryopreserved effectively, posing a greater threat to maternal genetic resources and necessitating the use of alternative management techniques. The use of Germ Stem Cell (GSC) modification techniques for surrogate reproduction is the only practical solution to this problem in fish at this time. The gonads include a population of cells known as germ stem cells, which have the capacity to develop into gametes while also retaining their stemness through self-renewal. So long as the fish is alive, GSCs can be acquired as embryonic primordial germ cells and afterwards as differentiated spermatogonia or oogonia.

Several techniques can be used to separate these GSCs and transplant them into the body of the surrogate host. Transplanted GSCs subsequently proliferate and produce gametes from donors after colonising the host's vaginal ridge. GSCs have a high level of sexual plasticity, which is crucial. In the gonadal environment of the host, transplanted male GSCs can transdifferentiate into female GSCs giving birth to fertile eggs and vice versa. Because both sperm and eggs may be produced even from a single donor, the sexual flexibility of GSCs offers tremendous promise. Moreover, transplantation can help with more sophisticated applications. From donors with homogametic sex chromosomes, monosex stocks can be created without the requirement for difficult methods of uniparental inheritance induction or hormonal treatments with potential environmental risks. Interspecific surrogacy is seen as a practical management strategy for essential or endangered aquaculture species. In both situations, interspecific transplanting can improve undesirable traits of the target species, such as slow maturation, large bodies with high space and cost requirements, or generally troublesome reproduction in captivity. Despite extensive and persistent efforts, the production of donor-derived seed from iconic species like long-maturing sturgeons or bluefin tuna has not yet been accomplished. Most surrogacy studies to date have evaluated the appropriateness of the chosen host and the transplanting process because both are essential conditions for effective gamete production. After intraspecific transplantation, effective generation of donor-derived gametes has been reported in numerous trials. Only three species have so far been documented to produce viable eggs from interspecific surrogates, showing that there may be challenges related to the evolutionary gap between two different species, which may result in some cell incompatibilities. On the other hand, donor-derived sperm production appears to have no limits, particularly when used in conjunction with intrapapillary transplantation. This can be demonstrated by the successful creation of surrogate sperm in organisms that belong to different taxonomic classes and diverged about 230 million years ago (mya). Yet, a groundbreaking study on surrogacy between masu salmon recipients and rainbow trout donor having divergence time 14.2 mya has produced the most remote successful creation of viable donor-derived eggs and sperm. In order to properly utilise the potential of this reproductive biotechnology, we underline that the ultimate goal of GSC manipulation technologies should be the creation of eggs from interspecific surrogates with some superior traits.

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