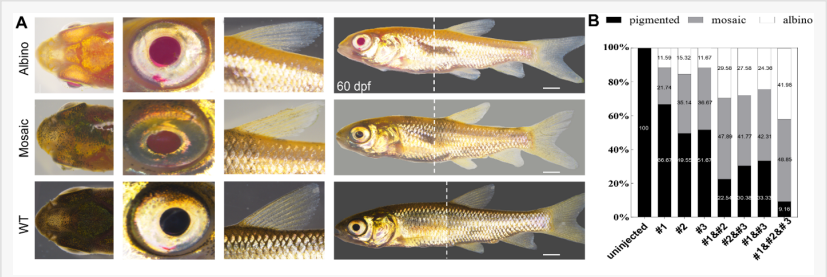
Biobreeding technology enables rapid development of golden Grass Carp germplasm



Efficient disruption of tyrb resulted in albino phenotype in F0 grass carp mutants.

FAYETTEVILLE, GA, UNITED STATES, March 27, 2025 /EINPresswire.com/ -- A study published in the KeAi journal Reproduction and Breeding marks the first successful use of CRISPR/Cas9 gene-editing technology to disrupt the tyrosinase-related protein B (tyrb) gene in grass carp (Ctenopharyngodon idella). The research resulted in the generation of red-eyed golden mutants and offered an innovative solution to address the genetic degradation of traditional gold grass carp.

Gold grass carp, prized for their golden body color, face challenges such as scarce natural germplasm resources and long-term reliance on inbreeding, leading to offspring with mottled coloration, high deformity rates and reduced disease resistance. To tackle this, the research team, based in China, targeted body color regulation genes and microinjected a mixture of tyrb-targeting gRNA and Cas9 protein into single-cell stage embryos.

The edited mutants (F0 generation) exhibited significantly reduced or absent melanophores, displaying uniform golden coloration and unique red eyes due to melanin loss in the ocular region. Compared to traditional black-eyed gold grass carp, these red-eyed mutants not only hold higher ornamental value but also demonstrate stable coloration (via irreversible melanophore loss), fundamentally eliminating inbreeding-induced color deterioration.

Notably, the combined use of multiple gRNAs enabled large-scale gene deletions and enhanced mutation efficiency, establishing a replicable technical framework for precision breeding in other fish species.

Interestingly, initial concerns about gene-editing impacts on survival were alleviated when tyrb knockout altered only pigmentation without developmental defects, suggesting this gene may specialize in pigment metabolism.

The findings represent a critical advance in molecular-designed breeding of grass carp. The stable golden germplasm developed could transform aquaculture practices, driving industrialization of high-value ornamental and edible varieties.

References

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