Reproductive Characteristics of Chub Mackerel with Follicle-Stimulating Hormone Receptor Gene Knockout

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Résumé

Knockout (KO) of the follicle-stimulating hormone receptor gene (*fshr*), which is specifically expressed in gonadal somatic cells, may induce sterility by causing their dysfunction. We established an *fshr*-KO strain in the chub mackerel (*Scomber japonicus*) using the CRISPR/Cas9 system and investigated its reproductive characteristics. F1 heterozygous KO individuals harboring a 23-base insertion causing a frameshift mutation were produced by crossing founder individuals with wild-type fish. Subsequently, F2 generation was obtained by mating F1 males and females. Among the F2 offspring, 25.6% were homozygous KO individuals. At 13 months, the gonadosomatic indexes (GSIs) of wild-type males and females were 9.4 ± 1.0 and 3.1 ± 1.4, respectively, whereas homozygous KO males and females had significantly lower GSIs (0.026 ± 0.003 and 0.43 ± 0.1, respectively). Histological analysis revealed that although wild-type males produced sperm, KO males had no germ cells beyond the spermatogonia stage. Similarly, wild-type females had well-developed yolk-stage oocytes, whereas KO females lacked oocytes beyond the previtellogenic stage. These data indicate that *fshr*-KO chub mackerel are sterile, at least during the spawning season at 1 year of age. As a further study, we intend to demonstrate the mass production of sterile fish by transplanting germ cells from *fshr*-KO fish into recipients with functional gonadal somatic cells. This strategy can be achieved using donor fish with normal germ cells but dysfunctional gonadal somatic cells and sterile recipient fish that lack germ cells and also possess functional gonadal somatic cells.

Mots-Clés: Aquaculture, Surrogate broodstock technology, Reproductive biotechnology, Mackerel, germ cell manipulation

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