

Closing

50 Years from Sex Reversal

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In the end of 2002, the Ministry of Environment, Japan, announced that they will launch a plan to generate a global standard of protocols for endocrine disrupters testing using medaka in Japan, fathead minnow in the United States, and zebrafish in Europe. The vitellogenin assay proposed as the key protocol reminds me that 2002 is the 50th anniversary of discovery of sex reversal by Tokio Yamamoto. First, he generated the d-rR strain by crossing of orange-red and white strains for five years in 1946-1950, in which the genetic sex is identified by the body color, that is, genetic males exhibit the red body and genetic females exhibit the white body. Then, he exposed this strain to estrogens or androgens, and obtained functional males with the white body and functional females with the red body. The sex reversal was proved in 1953. I recognize that our discussions of the endocrine disrupters in three medaka symposia from 2000 to 2003 are based on his framework of sex determination and differentiation.

In 1953, he noticed the possibility of mutation of sex-determining gene to interpret the presence of a small number of females with the red body or males with white body in control populations of the d-rR strain. The sex determining gene and its mutant genes were identified and cloned in 2002, which certainly becomes a root of toxicogenomics of endocrine disrupters. I also remind that the d-rR strain have been a key that induces the explosion of the medaka biology very recently, Y chromosome mapping, genome-wide mutagenesis, whole genome sequencing etc.

I hope, reminding Yamamoto's contribution in this field, that the third medaka symposium becomes the starting point for standardization of protocols by collaboration of three groups of medaka, fathead minnow and zebrafish.