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A study on the mutants, *cm* and *va*, of the gambusia, *Gambusia affinis*

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Abstract The body color mutant genes, *cm* and *va*, of the common gambusia, *Gambusia affinis*, are described. The homozygotes *cm/cm* and *va/va* give rise to the blond and black spot variants, respectively. The double recessive *cm/cm va/va* produces dull yellow fish. All of the genes are autosomal, and are not linked to each other.

Introduction

The common gambusia, *Gambusia affinis*, which inhabits North America was introduced into the western suburbs of Nagoya about 30 years ago, to expel mosquito larvae. This fish is viviparous and usually breeds once a month (Miyadi *et al.*, 1976), and has been propagated in paddy fields and brooks around Nagoya. The fish swarm to the surface, and grow and reproduce in summer. In winter, they sink to the bottom and a considerable number of fish die. I rear the gambusia outdoors from April to October while indoors from November to March. Pregnant females are reared individually to avoid the eating of young fish.

In 1983, two blond females were collected from a brook in Tobishima near Nagoya, which were easily distinguishable from black normal fish. Genetic analyses revealed that this blond body color was due to an autosomal, recessive mutant gene which I have designated *cm*. During the course of genetic analysis of *cm*, a novel variant with the dull yellow body color was segregated. Genetic analysis of this dull yellow variant disclosed the presence of a novel autosomal, recessive gene *va*, the homozygote of which showed the phenotype that was designated black spots. The dull yellow has been proved to be produced by the double recessive genes, *cm* and *va*.

The present paper describes the morphology of these variant fish and the results of genetic analyses of the two mutant genes, *cm* and *va*. A brief account on these genes has been given (Tomita, 1992).

Results and Discussion

Morphological observations

(1) Blond (*cm/cm*). Blond in body color. Melanin granules in melanophores are always concentrated, lacking the physiological response to environmental changes. The diameter of the black area of melanophores is about half that of the most concentrated wild-type melanophores. The number of melanophores is twice that of the wild type. The phenotype of this mutant is similar to that of the *cm* mutant of medaka, *Oryzias latipes* (Tomita, 1992) and that of the *b* mutant of the guppy, *Poecilia reticulata* (Goodrich *et al.*, 1944).

(2) Black spots (*va/va*). The body is rather transparent and has black spots. Melanophores are either colorless, lightly colored, or black. The black spots are due to the scattered pigmented melanophores, as in the *B'* mutant of medaka (Aida, 1921). Colorless and lightly colored melanophores change to black when they are histochemically subjected to the tyrosinase reaction, as in the case of the orange-red medaka (*bR*) (Hishida *et al.*, 1961). Iridocytes contain a small amount of guanine, resembling the phenotype of the *gu* mutant of the medaka (Tomita, 1992).

(3) Dull yellow (*cm/cm va/va*). Melanophores are colorless, lightly pigmented, or normally pigmented, giving rise to a whole body appearance that exhibits small spots.

Genetic analyses

The two blond females collected in 1983 were used for genetic analysis. They were already pregnant at the time of collection. The first female bred 15 wild-type fish. The F_2 progenies were segregated into 168 wild type (+) and 41 blond type (*cm*) in a ratio of 3:1 (χ^2=2.42, p=0.20–0.10). The result of the χ^2 test showed no significant deviation from the expectation.

Next, two crosses between the F_2 blond fish were made. In one case, the progenies were all blond (*cm*, 69 fish). In the other case, 22 blond (*cm*) and 6 dull yellow (*cm va*) fish were produced, the latter of which represented a novel phenotypic variant.

The second blond female bred 45 wild-type fish. The F_2 progenies were segregated into 99

wild type and 28 blond type (*cm*) in a ratio of 3:1 (χ^2=0.67, p=0.5–0.30). A cross between the F_2 blond fish produced 41 blonds. An F_2 blond female derived from the first original blond was mated with an F_2 blond male. The progenies were 56 blond. When an F_2 blond female derived from the second original blond was mated with an F_2 blond male derived from the first original blond, the progenies were again all blond (75 fish).

A dull yellow female was mated with a wild-type male. The F_1 progenies were 33 wild. The F_2 progenies were segregated into 102 wild-type (female 49, male 53), 29 blond-type (*cm*: female 17, male 12), 31 black spot-type (*va*: female 17, male 14), and 10 dull yellow-type (*cm va*: female 4, male 6) in a ratio of 9:3:3:1 (χ^2=0.81, p=0.90–0.80). The sex ratio was 1:1 (χ^2=2.94, p=0.90–0.80).

A wild-type female (++) was mated with a dull yellow male (*cm va*). The progenies were all wild type (21 fish). The F_2 progenies were 107 wild type, 31 blond (*cm*), 33 black spots (*va*) and 10 dull yellow (*cm va*) in a ratio of 9:3:3:1 (χ^2=0.81, p=0.90–0.80). Two crosses between the F_2 black-spots fish were made. In one case, the progenies were all black spots (*va*: 47 fish). In the other case, the progenies were 53 black spots (*va*) and 13 dull yellow (*cm va*).

These results are consistent with the idea that the homozygotes of the autosomal, recessive genes *cm* and *va* produce the blond and black spots, respectively, and that the homozygous double recessive genes *cm va* produce the dull yellow. *cm* and *va* are not linked to each other.

References

Aida, T. (1921) *Genetics*, **6**: 554–573.

Goodrich, H.G., N.D. Josephson, J.P. Trinkaus and J.M. Slate (1944) *Genetics*, **29**: 584–592.

Hishida, T., H. Tomita and T. Yamamoto (1961) *Embryologia*, **5**: 335–346.

Miyadi, D., H. Kawanabe and N. Mizuno (1976) Coloured illustrations of the freshwater fishes of Japan. Hoikusha Publ., Co., Osaka. pp. 276–277. (In Japanese).

Tomita, H. (1992) *Fish Biol. J. MEDAKA*, **4**: 45–47.