

Permethrin (CAS no. 52645-53-1, 61949-77-7, 51877-74-8, 54774-47-9, 61949-76-6, 54774-45-7, 54774-46-8 etc.)

## **Tier 1 *in vivo* Test**

### **(1) Results**

Fish were exposed to concentrations of 0.288, 1.49 and 8.43 µg/L (measured). No significant differences were observed in mortality, total length, male body weight, gonadosomatic index, male hepatosomatic index, male hepatic vitellogenin level, and secondary sex characteristics.

At 1.49 µg/L and higher, a significant decrease in female body weight and female hepatosomatic index were observed.

At 8.43 µg/L, a significant decrease in number of eggs, number of fertile eggs, fertility rate, and female hepatic vitellogenin level were observed.

### **(2) Summary**

Estrogenic activity of permethrin has been indicated from literature and Tier 1 *in vitro* tests. In this study, no increase in male hepatic vitellogenin level was observed at sublethal concentrations to suggest estrogenic effect.

It was also not concluded that permethrin is an androgenic compound.

A statistically significant decrease in female hepatic vitellogenin level and number of eggs were observed to suggest anti-estrogenic effect.

The adverse exposure level of 8.43 µg/L was ca. 27,200 times as high as the detection limit of environmental water concentration of 0.00031 µg/L that was measured in MOE's Environmental Survey and Monitoring of Chemicals in FY2018 (permethrin was not detected).

The no observed adverse effect level of 1.49 µg/L was ca. 4,800 times as high as the detection limit of environmental water concentration of 0.00031 µg/L for MOE's Environmental Survey and Monitoring of Chemicals in FY2018 (permethrin was not detected).

Table 1-A Results

| Measured concentration ( $\mu\text{g/L}$ ) | Number of tested fish |        | Total length (mm) |        | Body weight (mg) |                | Total length (mm) |                             |
|--------------------------------------------|-----------------------|--------|-------------------|--------|------------------|----------------|-------------------|-----------------------------|
|                                            | male                  | female | male              | female | male             | female         | male              | female                      |
| Control                                    | 12                    | 12     | 0                 | 0      | 30.6 $\pm$ 0.9   | 31.5 $\pm$ 1.2 | 315 $\pm$ 55      | 385 $\pm$ 40                |
| Solvent Control                            | 12                    | 12     | 0                 | 8      | 30.0 $\pm$ 1.2   | 31.6 $\pm$ 1.0 | 290 $\pm$ 40      | 425 $\pm$ 29                |
| 0.288                                      | 12                    | 12     | 0                 | 0      | 29.9 $\pm$ 1.0   | 31.6 $\pm$ 1.2 | 293 $\pm$ 36      | 414 $\pm$ 46                |
| 1.49                                       | 12                    | 12     | 0                 | 0      | 29.6 $\pm$ 0.8   | 31.4 $\pm$ 1.5 | 284 $\pm$ 27      | 389 $\pm$ 60** <sup>1</sup> |
| 8.43                                       | 12                    | 12     | 0                 | 0      | 30.7 $\pm$ 1.5   | 31.2 $\pm$ 1.3 | 322 $\pm$ 42      | 390 $\pm$ 51** <sup>1</sup> |

\*\*<sup>1</sup>: Statistically significant differences from solvent control group

Table 1-B Results (continued)

| Measured concentration ( $\mu\text{g/L}$ ) | Number of eggs (eggs/female/day) | Number of fertile eggs (eggs/female/day) | Fertility rate (%) | Gonadosomatic Index (%) |                 |
|--------------------------------------------|----------------------------------|------------------------------------------|--------------------|-------------------------|-----------------|
|                                            |                                  |                                          |                    | male                    | female          |
| Control                                    | 23.8 $\pm$ 1.7                   | 20.7 $\pm$ 2.5                           | 86.8 $\pm$ 5.9     | 1.03 $\pm$ 0.49         | 8.38 $\pm$ 1.6  |
| Solvent Control                            | 24.7 $\pm$ 2.0                   | 19.9 $\pm$ 2.7                           | 80.0 $\pm$ 6.0     | 0.893 $\pm$ 0.18        | 7.85 $\pm$ 2.1  |
| 0.288                                      | 24.2 $\pm$ 2.5                   | 20.8 $\pm$ 2.4                           | 85.8 $\pm$ 5.2     | 1.20 $\pm$ 0.56         | 8.97 $\pm$ 1.5  |
| 1.49                                       | 24.8 $\pm$ 2.2                   | 18.4 $\pm$ 3.5                           | 74.3 $\pm$ 8.2     | 0.997 $\pm$ 0.30        | 9.15 $\pm$ 0.89 |
| 8.43                                       | 20.2 $\pm$ 2.1*                  | 13.7 $\pm$ 3.1**                         | 68.3 $\pm$ 13.6**  | 0.984 $\pm$ 0.23        | 8.65 $\pm$ 1.1  |

Table 1-C Results (continued)

| Measured concentration ( $\mu\text{g/L}$ ) | Hepatosomatic Index (%) |                                | Vitellogenin (ng/mg liver) |                 | Secondary sex characteristics |           |
|--------------------------------------------|-------------------------|--------------------------------|----------------------------|-----------------|-------------------------------|-----------|
|                                            | male                    | female                         | male                       | female          | male                          | female    |
| Control                                    | 1.88 $\pm$ 0.65         | 4.45 $\pm$ 0.77                | 9.72 $\pm$ 32.2            | 879 $\pm$ 227   | 57 $\pm$ 6                    | 0 $\pm$ 0 |
| Solvent Control                            | 2.19 $\pm$ 0.70         | 5.26 $\pm$ 0.86                | ND                         | 995 $\pm$ 755   | 62 $\pm$ 11                   | 0 $\pm$ 0 |
| 0.288                                      | 2.13 $\pm$ 0.56         | 4.97 $\pm$ 0.63                | ND                         | 830 $\pm$ 170   | 61 $\pm$ 12                   | 0 $\pm$ 0 |
| 1.49                                       | 2.04 $\pm$ 0.42         | 4.46 $\pm$ 0.68** <sup>1</sup> | ND                         | 867 $\pm$ 233   | 58 $\pm$ 9                    | 0 $\pm$ 0 |
| 8.43                                       | 2.11 $\pm$ 0.32         | 4.65 $\pm$ 0.89** <sup>1</sup> | ND                         | 618 $\pm$ 186** | 60 $\pm$ 10                   | 0 $\pm$ 0 |

\*\*<sup>1</sup>: Statistically significant differences from solvent control group

Table 1-D Results (continued)

| Measured concentration ( $\mu\text{g/L}$ ) | Other observations                                                                                                                                 |
|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| Control                                    | Not found                                                                                                                                          |
| Solvent Control                            | Not found                                                                                                                                          |
| 0.288                                      | Not found                                                                                                                                          |
| 1.49                                       | Abnormal gross morphology (breeding) was found in a fish on the 9 <sup>th</sup> day of exposure, but it was not found on the 10 <sup>th</sup> day. |
| 8.43                                       | Abnormal gross morphology (breeding) was found in a fish on the 9 <sup>th</sup> day of exposure, but it was not found on the 10 <sup>th</sup> day. |

Data show mean  $\pm$  SD (standard deviation)

Statistically significant differences from control group (\*\*p<0.01, \*p<0.05)

ND: not detected (below detection limit of vitellogenin: 0.4 ng/mg liver)

(-): not measured

Secondary sex characteristics: number of joint plates with papillary processes