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EFFECT OF SOME FEMALE STEROID SEX HORMONES (17B-ESTRADIOL, ESTRIOL, PROGESTERONE) ON THE LIFE CYCLE OF *DAPHNIA PULEX*

ВПЛИВ ДЕЯКИХ ЖІНОЧИХ СТЕРОЇДНИХ СТАТЕВИХ ГОРМОНІВ (17B-ЕСТРАДІОЛУ, ЕСТРІОЛУ, ПРОГЕСТЕРОНУ) НА ЖИТТЄВИЙ ЦИКЛ DAPHNIA PULEX

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Over the past two decades, a large number of reports were published raising concerns about the environmental problems regarding the increasing global use of pharmaceuticals and their detection in surface waters around the world [5]. One of the main potential dangers associated with the discharge of these substances into water bodies is the ability to affect the reproductive system of aquatic organisms and cause disturbances in ecosystem functioning. Pharmaceutical products enter the aquatic environment through biomedical, veterinary, agricultural, and industrial routes [4].

The term "endocrine-disrupting compounds" is commonly used to describe chemicals that alter endocrine metabolism and include a large number of compounds, from natural substances (hormones such as estrone, 17β-estradiol, and estriol) to synthetic ones (pesticides, pharmaceuticals, etc.) [1, 2, 3].

Examination of available literature shows that exposure of *Daphnia magna* to 17β-estradiol caused transcriptional changes in the immune system, disintoxication, disease prevention, and protein degradation pathways [10]. Under the effect of 17α-ethinylestradiol alterations in the puberty rate, a decrease in the growth rate, oxidative stress, and lipid peroxidation as well as genotoxic damage were detected [8]. In long-term exposure of *Daphnia magna* to the mixtures of four progestogens (progesterone, drospirenone, gestodene, levonorgestrel), the number of days until production of the first eggs was reduced at the 10 ng/l concentration compared to control, furthermore, the maximum egg number per individual increased at the concentrations of 1 and 10 ng/l [9].

The purpose of this work was to study the effect of steroid female sex hormones 17*β*-estradiol, estriol and progesterone on the growth, development and reproduction of *Daphnia pulex* using the scheme of a subchronic 27-day experiment. Up-to date reproductive assays with daphnids should involve both parthenogenetically reproducing females and the assessment of effects on sexual reproduction [7]. The rate of somatic growth and puberty age, the dynamics of potential (the number of eggs laid) and actual (the number of newborns) fertility were determined, and the sex of youngs in successive broods were recorded.

To study the effect of these substances on *D. pulex*, ecologically relevant concentrations were used (0.3; 3; 30 mkg/l), which are typical for effluents of wastewater treatment plants or probable in the case of discharge of untreated wastes (middle and highest concentration, respectively) [6].

It was demonstrated that the effect of 17β-estradiol in concentrations of 3 and 30 mkg/l caused a decrease in the number of parthenogenetic eggs laid in the first two (up to 14 days of exposure) broods of *D. pulex* females. In the third and fourth broods (14–21 days of exposure), the number of newborns did not differ from the control indicators, which could be a manifestation of the adaptation of the reproductive processes of Daphnia females to the influence of exogenous 17*β*-estradiol.

After 21 days of exposure, an increase in the fertility of females cultured in containers with the addition of 17*β*-estradiol was observed at all studied concentrations. Thus, the number of newborns in this period at a concentration of 0.3 mkg/l was about 2 times higher than that of the control group, and at exposure to 3 and 30 mkg/l – by 1.6 and 1.2 times, respectively. It should be noted that under the influence of all examined concentrations of 17*β*-estradiol and estriol, no alterations in the time of appearance of gonads was detected compared to control individuals, i.e. they did not affect the rate of puberty of daphnia. Also, no acceleration or retardation of the time of embryonic development was registered.

Under the effect of estriol, a decrease in the number of parthenogenetic eggs was observed during the first two broods. By the 19th day of the experiment, a sharp increase in fertility was observed under the influence of estriol concentrations of 3 and 30 mkg/l. Thus, the number of parthenogenetic eggs laid in these two next consecutive broods at the middle and highest concentration were about 1.5 times higher than the control and concentration 0.3 mkg/l indicators. It is important to note, that this stimulation was followed by a sharp decline in the fertility at the concentrations 3 and 30 mkg/l. As a consequence, the highest fertility is observed under the effect of estriol at a concentration of 0.3 mkg/l.

The effect of progesterone caused the delay in the puberty rate of female juveniles of *D. pulex*. Under the influence of progesterone at a concentration of 0.3 mkg/l the delay amounted to about two days, and under the effect of concentrations 3 and 30 mkg/l – about five days. That is why by the 14th day of the experiment, the fertility rate of females was lower than the control indicators for all examined concentrations. Under the effect of a concentration of 0.3 mkg/l, by the 18th day of exposure, the number of parthenogenetic eggs laid in consecutive broods was equal to the control ones.

In conclusion, it should be noted that the presence of s 17*β*-estradiol, estriol, and progesterone in the cultural medium in ecologically relevant concentrations (0.3; 3 and 30 mkg/l) do not stimulate the homogenesis and emergence of males, i.e., female sex steroid hormones do not alter the reproduction strategy of *D. pulex* by switching from parthenogenetic to sexual reproduction. The effect of progesterone, in contrast to 17*β*-estradiol and estrone, caused an increase in the period required for puberty in juvenile females following the increase in concentration. Identification and understanding of the mechanisms of direct and indirect effects of these compounds on Cladocerans are of considerable theoretical interest and require further research.

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