RINGKASAN

KONSENTRASI ESTRADIOL-17β DI DALAM AIR SUNGAI BRANTAS DAN PENGARUHNYA TERHADAP FEMINISASI IKAN NILA (*Oreochromis niloticus*) SECARA EKSPERIMENTAL

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Senyawa estrogenik adalah senyawa yang beraksi seperti estrogen, banyak dijumpai di lingkungan, terutama di perairan. Dampak senyawa ini terhadap organisme adalah terjadinya pertumbuhan gonad jantan abnormal, feminisasi, interseks atau hibrigonad, kualitas spermatozoa menurun dan akhirnya cenderung menimbulkan punahnya spesies. Salah satu senyawa estrogenik alami yang potensial adalah estradiol-17β yang banyak diekskresi oleh manusia dan mamalia.

Berdasar berbagai penelitian, estradiol-17β berpengaruh negatif terhadap perkembangan organ reproduksi jantan hewan vertebrata, baik pada mamalia, burung, reptil, amfibi maupun ikan (Roy, 1995, Stancel, et al., 1995, Horowitzs, et al., 2000, Cody, 2001, dan Tabata, et al, 2001). Pada hewan-hewan tersebut senyawa estrogenik dapat mendorong terjadinya feminisasi dan gangguan reproduksi.

Sungai Brantas mengalir melalui pemukiman, pertanian, dan digunakan sebagai tempat mandi, cuci, kakus (MCK). Karena itu patut diduga bahwa kandungan estradiol-17β di sungai Brantas cukup tinggi. Hal yang demikian dapat membahayakan lingkungan.

Penelitian ini bertujuan untuk menguji pengaruh kadar estradiol-17β di dalam sungai Brantas terhadap feminisasi ikan nila *(O. niloticus)*, serta pengaruhnya terhadap pertumbuhan tubuh, gonad dan gamet. Penelitian dilakukan melalui tahap I mengukur konsentrasi estradiol-17β di aliran sungai Brantas, tahap II eksperimen untuk larva ikan berumur 1 minggu hingga berumur 4 bulan, dan tahap III eksperimen untuk ikan umur 4 bulan hingga berumur 7 bulan.

Pada tahap I air sungai dianalisis dengan teknik radioimmuno assay (RIA) guna menentukan konsentrasi estradiol-17β di dalamnya. Pada tahap II, larva ikan nia *(O. niloticus)* umur 1 minggu direndam dalam larutan estradiol-17β dengan teknik *static-renewal*, dua minggu tidak berturut-turut (Tabata, et al, 2001, Horowitzs, et al, 2000), dan diamati ketika berumur 4 bulan. Konsentrasi larutan uji adalah konsentrasi A = 0 ng/l (sebagai kontrol), B = 100 ng/l (konsentrasi sungai Brantas), C = 550 ng/l dan D = 1000 ng/l (konsentrasi yang menimbulkan feminisasi 100% ikan medaka). Pada tahap III ikan umur 4 bulan diberi perlakuan lagi dengan teknik dan konsentrasi larutan yang sama, kemudian dipelihara di tambak hingga mencapai umur 7 bulan untuk diamati pertumbuhannya. Percobaan ini menggunakan rancangan acak lengkap.

Hasil penelitian menunjukkan bahwa di daerah Batu, Malang, rerata konsentrasi estradiol-17 85,833 ± 35,932 ng/l, di daerah Tulungagung 112,500 ± 55,077 ng/l, dan di daerah Surabaya 117,500 ± 36,393 ng/l. Konsentrasi estradiol-17β di sungai-sungai Eropa berkisar antara 0,1 – 88 ng/l, sedang di sungai Brantas berkisar antara 42 – 220 ng/l.

Estradiol-17β konsentrasi sungai Brantas (100 ng/l) dapat mengakibatkan feminisasi ikan nila (*O. niloticus*) umur 7 bulan, berpengaruh signifikan terhadap pertumbuhan ikan nila *(O. niloticus)*, baik di umur 4 bulan maupun 7 bulan. Estradiol-17β berpengaruh signifikan meningkatkan panjang, lebar dan berat tubuh ikan. Semakin meningkat konsentrasi larutan, semakin meningkat pertumbuhan ikan. Pengaruh terhadap ikan jantan lebih tinggi daripada ikan betina. Estradiol-17β berpengaruh signifikan menurunkan berat gonad jantan, viabilitas spermatozoa, dan jumlah telur, tetapi berpengaruh tidak signifikan dalam menurunkan gerak massa spermatozoa, gerak individu spermatozoa, lama hidup spermatozoa, berat gonad betina, penampang telur, dan berat telur. Semakin meningkat konsentrasi larutan estradiol-17β mempunyai kecenderungan semakin menurunkan berat gonad jantan dan kualitas spermatozoa.

Indeks feminisasi ikan nila (*O. niloticus*) umur 4 bulan akibat perlakuan A (0 ng/l) = 1, B (100 ng/l) = 1 (tidak mengalami feminisasi), C (550 ng/l) = 1,973 dan D (1000 ng/l) = 2,666, sedang pada umur 7 bulan indeks feminisasinya A (0 ng/l) = 1, B (100 ng/l) = 1,2, C (550 ng/l) 1,819, dan D (1000 ng/l) = 2,166. Jika dirata-rata, indeks feminisasi ikan dari umur 0-7 bulan adalah A (0 ng/l) = 1, B (100 ng/l) = 1,44, C (550 ng/l) = 1,66 dan D (1000 ng/l) = 1,66. Semakin meningkat konsentrasi estradiol-17β, semakin tinggi indeks feminisasinya.

Mengingat air sungai digunakan untuk berbagai keperluan penduduk, dikhawatirkan senyawa estrogenik yang ada di dalamnya membahayakan organisme dan manusia. Karena itu perlu diadakan penelitian lanjutan untuk menguji berbagai senyawa estrogenik di sungai, laut, air minum dan di dalam tubuh biota air.

SUMMARY

ESTRADIOL-17β CONSENTRATION IN BRANTAS RIVER AND ITS EFFECT ON FEMINIZATION OF NILA FISH (*Oreochromis niloticus*) EXPERIMENTALE

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Estrogenic compound is the substance that react as estrogen, mostly found in the environment, mainly in the water. The effects of this compound on organism were the incidence of abnormal growth of gonad male, feminization, intersex or hibrigonad, decreased spermatozoa quality. One of potential, natural estrogenic compound is estradiol-17β, which is much excreted by human being and mammals.

Based on some studies, estradiol-17β has negative effect on the development of reproductive organs and vertebrata gamet, either on mammals, birds, reptile, amphibian and fishes (Tabata, et al, 2001, Cody, 2001, Horowitzs, et al., 2000, Stancel, 1995, and Roy, 1995). Such animals feminization and reproduction disorder as well.

Brantas river streams through settlement and agriculture areas as well as being utilized for washing, bathing, and wasting. Therefore, it can possibly be assumed that estradiol-17β content within the water of Brantas river is so high. This is considered being able to endanger environment.

The aim of this research was to identify the effect of estradiol-17β concentration of Brantas river on nila fish *(O. niloticus)*, as well as its impact on the feminization, the growth of both gonad and gamets. This study was conducted through three phases, consisting of Phase I-The measurement of estradiol-17β concentration in Brantas river; Phase II-Experiment, in order to know the effect of estradiol-17β on the juvenile at its one week through four months age; and Phase III-Experiment, in order to know the effect of estradiol-17β on the 4 to 7 months-aged fishes.

On the phase I, the river's water was analyzed using radioimmuno assy (RIA) in order to determine estradiol-17β concentration. On Phase II, a week-aged *O. niloticus* juveniles were kept in the estradiol-17β solution using static-renewal technique for two weeks irrespectively (Tabata et al., 2001, Horowitz et al., 2000), and observed when they were at their 4 months age. Test solution concentration was concentration A=0 ng/l (control), B=100 ng/l (concentration of Brantas river), C=550 ng/l and D=1000 ng/l (concentration causing 100% feminization of medaka fish). On phase III, those four months-aged were treated again using technique and concentration of similar solution, then cultured in fishpond untill they achieved their 7 months to be observed their growth. This experiment used complete random design.

The experiment results indicated that estradiol-17β concentration in Brantas river was sufficiently higher than that of those in developed countries. In Batu, Malang, the average concentration of estradiol-17β was 85,883 ng/l ± 35,392; in Tulungagung was 112,500 ng/l ± 55,077, and in Surabaya area was 117,500 ng/l ± 36,393. The Estradiol-17β concentration was in the range of 42 – 220 ng/l.; whereas the Estradiol-17β concentration was in European rivers were at the range of 0,1 – 88 ng/l.

It was found that estradiol-17β consentration of Brantas river (100 ng/l) had affected the feminization over male nila fish (*O. niloticus*) at 7 months of age. Estradiol-17β had increased significantly on the growth of nila fish *(O. niloticus)* at either its 4 or 7 months age, affected on its length, width, and weight. The higher concentration of the solution, the more increased its growth. The effect on the male was higher than on female. Estradiol-17β affected decrease significantly on the male's gonad weight, spermatozoa viability, and the number of eggs; but insignificantly on mass movement of spermatozoa, individual movement of spermatozoa, spermatozoa durability, female's gonad weight, egg appearance, and weight of eggs. The higher concentration of solution, the more decreased male's gonad weight and spermatozoa quality.

Those males fish feminization were measured to determine their feminization index. Feminization indices for those in 4 months-aged due to the treatment were A (0 ng/l) = 1, B (100 ng/l) = 1 (meaning no feminization), C (550 ng/l) = 1,973 and D (1000 ng/l) = 2,666 respectively; while for those in 7 months age were A (0 ng/l) = 1; B (100 ng/l) = 1,2; C (550 ng/l) = 1,819; and D (1000 ng/l) = 2,166. When these were measured in average, the feminization indices for 0 –7 months aged-fishes were A (0 ng/l) = 1; B (100 ng/l) = 1,44; C (550 ng/l) = 1,66; and D (1000 ng/l) = 2,166. The higher concentration of estradiol-17β, the higher its feminization index.

In view of that the river's water is mostly used for various people needs, estrogenic compound contained was considered possibly endangering any organism and human beings. It is important to conduct further investigation in order to examine several estrogenic compounds contained either in the river, sea, organism, or drinking water.

ABSTRACT

ESTRADIOL-17β CONSENTRATION IN BRANTAS RIVER AND ITS EFFECT ON FEMINIZATION OF NILA FISH (*Oreochromis niloticus*) IN EXPERIMENTAL

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This research was conducted to prove the effect of estradiol-17β concentration in water of Brantas river on feminization and its impact on the growth of gonad of nila fish *(O. niloticus)*. There were 3 phases in this research. Phase I, was to measure estradiol-17β concentration in water of Brantas river. Sample were collected from up steram (Batu), middle (Tulungagung) and down stream (Surabaya); Phase II, the effect of estradiol-17β on the juveniles of nila fish at 1 week through 4 months of age; and Phase III, the effect of estradiol-17β on the 4 to 7 months of age fishes; In the phases II and III, the fishes were kept in the estradiol-17β solution using static-renewal technique. The concentration of estradiol-17β were 0 ng/l, 100 ng/l (concentration of Brantas river), 550 ng/l and 1000 ng/l. This experiment used completely randomized design.

The results of measurement showed that the concentration of estradiol-17β in up stream, middle and down stream of Brantas river were 85,883 ng/l ± 35,392; 112,500 ng/l ± 55,077, and 117,500 ng/l ± 36,393 respectively. The range concentration was 42 – 220 ng/l.

The result of experiment phase II dan III indicated that estradiol-17β concentration in Brantas river had affected: 1) the feminization over *O. niloticus* male fish at 7 months age. The higher estradiol-17β concentration, the higher feminization's index as well; 2) estradiol-17β increased significantly on the fish growth (their length, width, and weight), where the male fishes were more sensitive than female. 3) decreased significantly on the male's gonad growth and quality of spermatozoa, including: a) the male gonad's weight and b) the spermatozoa viability. 4) decreased significantly on the number of eggs.

Key words: Nila fish, *Oreochromis niloticus*, estradiol-17β, feminization, estrogenic compound, Brantas river.