

## 7 Summary

### Investigation of Biodegradation of Estrogens in the Aquatic Milieu

Endocrine disruptors may adversely affect the health of animals and possibly that of humans. Compared to xenoestrogens, there has been little investigation of the significance of natural estrogens although the latter occur especially in the aquatic environment.

The subject study investigates the changes in concentration of estrone and 17 $\beta$ -estradiol in the aquatic milieu in the presence of an enzyme-immunoassay. The investigations are based on the hypothesis that estrogens outside an organism are microbiologically decomposed. The changes in concentration were investigated in river water and were compared to the changes in concentration in sterilized water. Samples of water containing estrone and 17 $\beta$ -estradiol respectively were stored for 56 days at temperatures of 5 °C, 20 °C and 30 °C respectively. Furthermore, the influence of activated sludge and individual species of bacteria on estrogens in the water was considered.

The study produced the following results:

1. In river water, a pronounced decrease of the concentration of estrone was observed during the 56 days of storage. At 5 °C it took up to 42 days until more than 90 % of the initial concentration were decomposed. When stored at temperatures of 20 °C and 30 °C, however, 90 % of the initial concentration were decomposed after 2 to 14 days.

The decomposition is interpreted as biodegradation.

2. The decomposition of 90 % of the initial concentration of 17 $\beta$ -estradiol took 4 to 12 days at a temperature of 20 °C.

17 $\beta$ -estradiol is decomposed at a rate similar to that of estrone.

3. During the 56 days of storage, the concentrations of estrone and 17 $\beta$ -estradiol in aqua bidest. as well as in sterilized river water and in sterilized activated sludge remained at levels similar to the initial concentrations. The storage temperature did not affect the concentrations.

Hence, non-biological factors which might cause a significant decomposition are ruled out.

4. Activated sludge extracted from a sewage treatment plant accelerated the decomposition of estrone during storage.

The microorganisms contained in the activated sludge are adapted to the utilization of estrone.

5. The estrone concentration remained constant in the presence of *Escherichia coli*, *Pseudomonas fluorescens* or *Aeromonas hydrophila*.

Being isolated from the other species, the bacteria are not able to biodegrade estrone under the given conditions.

6. Several microtiter plates were used for one single experiment. Since every microtiter plate had to be initially calibrated, the same concentrations could lead to different concentration readings.

To avoid errors, only one plate per experiment should be used.

7. The curves of the estrogen concentration were described using different kinds of mathematical functions. For a logistic function, the sum of the square deviations is smaller than for an exponential or double-exponential function.

Hence, the logistic function is suitable to be adapted to the data.

This study contributes to the understanding of decomposition of estrogens in river waters. It therefore serves as a basis for assessing the risks of estrogens in the aquatic environment.