

EFFECT MONITORING FOR ENDOCRINE DISRUPTING SUBSTANCES IN THE RHINE RIVER

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ABSTRACT

The Rhine Waterworks Association, RIWA, is an organization in the Netherlands in which the water utilities along the river Rhine are working together in an attempt to reduce the levels of pollutants in their source water. One of the instruments RIWA employs is a joint monitoring program in which chemical, as well as microbiological water quality variables are being studied. In addition, special surveys are carried out in which effects are determined rather than specific individual substances and their concentrations.

Earlier, a national survey in The Netherlands indicated that sewage treatment plants are an important contributor of endocrine disrupting substances. This survey, however, was limited to estrogenic hormone (the female sex steroid hormone) effects. Recently, methods have become available for the detection of other classes of hormone activity, including tests for the androgen, progestagen, thyroid and glucocorticoid hormone receptor. Androgens are the male sex steroid hormones, such as testosterone, while progestagens are pregnancy hormones involved in the female menstrual cycle, gestation and embryogenesis.

Thyroid hormones are of paramount importance in a multitude of metabolic processes. Apparently, thyroid disorders have a high incidence and, consequently, thyroid medication is abundant in volume making such drugs interesting from a viewpoint of emission from treatment plants.

Glucocorticoid hormones promote the degradation of proteins and subsequent synthesis of glucose, especially in response to energy-demands such as stress, cold or physical effort.

They also suppress the immune system and it is for this function that synthetic glucocorticoids are widely prescribed and used (e.g. prednisone). Emission of these drugs to sewage and, subsequently, surface water is therefore expected to be significant.

In order to obtain some more insight in the levels of different hormonal mimicking activities and fluctuations thereof over time, a suite of endocrine tests has now been included in the routine monitoring program, both at intake sites for drinking water production and at the Dutch-German border where the Rhine river enters the Netherlands. The suite consists of the ER-, AR-, PR-, TR β -, and GR-CALUX[®], which measure estrogen, androgen, progestagen, thyroid, and glucocorticoid hormone-like activity, respectively.

First results (from aug-dec 2007) show estrogenicity levels similar as detected in the years before (< 1 ng/L estradiol equivalents), indicating the samples are representative. Androgenic and progestagenic levels are lower (up to 0.05 ng/L reference equivalents), while glucocorticoid levels are higher (up to 2.6 ng/L dexamethasone equivalents). No thyroid receptor activity was detected with this receptor-based assay, contrary to earlier activities detected with thyroid-binding proteins in the same surface waters. These results call for an assessment of the glucocorticoid levels in drinking water and the health risk posed by these levels.

KEY WORDS

Endocrine disruption, effect measurements, monitoring network, drinking water.