

# Estrogenic endocrine disruptors present in sports supplements. A risk assessment for human health

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## Abstract

Sports supplements are becoming a regular dietary addition for consumers who view such products as a means of improving their health and performance. Previously estrogenic endocrine disruptors (EDs) were detected in 80% of 116 sports supplements investigated by biological in vitro reporter gene assays (RGAs). The aim of this study was to quantify the hormonal activity in 50 of these sports supplement samples using a validated estrogen RGA and perform an exposure and risk assessment for human health.

Results showed that 17 $\beta$ -estradiol equivalent levels were higher than those reported as being present in the typical human omnivore diet in 33 of the sports supplements and higher than the acceptable daily intake (ADI) in 13 of these products. The highest activity samples presented a potential to influence the human daily exposure to 17 $\beta$ -estradiol like activity in various risk groups with a predicted hormonal impact of greatest concern in young boys and postmenopausal women. In conclusion, consumers of sports supplements may be exposed to high levels of estrogenic EDs.

**Keywords:** Bioassay; Dietary supplements; Endocrine disruptor; Environmental contamination; Estrogen; Food safety; Human health; Phytoestrogen; Reporter gene assay; Risk assessment.

# Estrogenic Activities of Food Supplements and Beers as Assessed by a Yeast Bioreporter Assay

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## Abstract

Mounting evidence of the effects of endocrine-disrupting chemicals (EDCs) in humans has led to assaying a vast array of food items (processed or packaged) as possible sources of human exposure to estrogens.

In this study, we investigated the current situation in this respect of different food supplements and beer brands. Eleven food supplements and 24 beer brands were obtained from Helsinki, Finland. Sample preparation was carried out by established methods while estrogenic activities were assessed by a yeast bioluminescent assay, using two recombinant yeast strains (*Saccharomyces cerevisiae* BMAEReluc/ER $\alpha$  and *S. cerevisiae* BMA64/luc). All the food supplements as well as 81% of the beer samples tested were found to be estrogenic, with estradiol equivalent concentrations of food supplements and beer brands ranging from 7.5 to 11.5  $\mu\text{g/ml}$  and from below detection limits to 43.6 ng/ml, respectively.

The estrogenic activities detected in beer samples were not dependent on the beer's alcoholic content, the country of production, or the size of the production brewery. The results of our study imply that both food supplements and beers can be a significant source of human exposure to estrogens. Therefore, further studies and regular surveillance are warranted.

**Keywords:** beer; bioassay; endocrine-disrupting chemicals; estrogenic activity; food supplements; isoflavones; isoxanthohumol; phytoestrogens.