Cultured keratinocytes obtained from human hair follicles might be a useful tool to study mutagenicity in human epithelial cells. Human hair follicles possess a cytochrome P-450 dependent enzyme system which is capable to metabolize xenobiotics. The preservation of this enzyme in vitro is important for the application of hair follicle cell cultures in genotoxicity studies especially for promutagens and procarcinogens.

We studied the immunolocalization of cytochrome P-450 using monoclonal antibodies (K03 and K07) raised against two isoenzymes. The antibodies were present in freshly plucked hair follicles, fibroblasts and the cell line SVKJ4. In the cultured keratinocytes no staining was observed by the antibodies. Since the cell line SVKJ4 shows a medium dependent response on the antibodies, the absence of cytochrome P-450 in the hair follicle keratinocytes is ascribed to the culture conditions. Further studies on the relation between culture regulations and maintenance of cytochrome P-450 is required.

NANOMOLAR CONCENTRATIONS OF Ca2+ INHIBIT Ca2+ TRANSPORT SYSTEMS IN PLASMA MEMBRANE AND INTRACELLULAR Ca2+ STORES. P.M. Verboort, R.A.C. Lock, C.M. van Os and S.E. Wendelsta Ronja.

Exposure of fish to cadmium (Cd) in the water causes a spectrum of toxic effects that is well documented. The mechanisms of Cd-toxicity, however, are largely unknown. A transient hypocalcemia is observed in fish the first days after Cd-exposure, which is indicative of a disturbed Ca2+ homeostasis. For freshwater trout it was demonstrated (1) that branchial Ca2+-influx (which is a transcellular event depending on the molecular level.


The synthetic food antioxidant 2,3-tet-butyl-4-hydroxyanisole (BHA) is carcinogenic in the forestomach of rats, hamsters and probably mice. Sequential changes are dose-dependent and involve lesions, hyperplasia, papillomas and carcinomas, the development of which is accompanied by an increase in forestomach labelling index (L.I.). In the present study, subcellular markers of cell kinetics were assessed in the rat gastro-intestinal tract after short-term consumption of BHA.

Groups of five male Wistar rats (306±7g) were fed a diet containing 2% BHA or basal diet (control group) for two weeks. Subsequently, rats were injected i.p. with 25 mg/kg 5-bromodeoxyuridine (BrdU), a thymidine analogue, and killed after four hours. The gastro-intestinal tract was removed, opened longitudinally, cleaned and fixed in 70% ethanol. After pepsin digestion of random samples of the fixed tissues, labelled cell nuclei were visualized by means of a monoclonal anti-BrdU antibody technique. Cell kinetic parameters were determined by bivariate BrdU/DNA analysis using flow cytometry.

Forrestomach L.I. and potential doubling time (Tpot) in random samples were 10.0±3.4% and 2.7±0.8 days for the control group and 20.7±3.5% and 1.4±0.2 days for the group fed 2% BHA respectively (mean ± SD, n=0.001). Mean transit time through the 5-phase was not altered. Glandular stomach, ileum, caecum and colon were not affected. Thus, we confirm proliferative effects of BHA on rat forestomach as indicated by an increase in L.I. and additionally report a decrease in Tpot following short-term dietary BHA administration.

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MUTAGENIC ACTION OF SOME ISOCYANATES AND THEIR AMINE ANALOGUES TO SALMONELLA TYPHIMURIUM A.M. Wetzer, H. Weetink, E.C. Rietveld and F. Seutter-Berlage

Organic isocyanates are highly reactive chemicals characterised by the general formula R(NCO)2. The isocyanates are widely used for the industrial production of polyurethanes. Exposure to isocyanates is known to cause pulmonary and skin irritation as well as immunological sensitization of the respiratory tract. In contrast to these well studied toxic effects, little is known about the mutagenic and possible carcinogenic effects of the isocyanates.

We present a study of the mutagenic action to Salmonella typhimurium of three isocyanates extensively used in polyurethane industry: toluene diisocyanate (TDI), 4,4'- diisocyanate and hexamethylene diisocyanate (HDI). In addition, the closely related toluidine was also studied. Isocyanates easily form amines in a reaction with water.

The mutagenic activity was carried out with the plate incorporation assay as described by Ames et al. (1). The tests were performed with S. typh. strains TA 100, TA 1535, TA 98 and TA 1538 both with and without metabolic activation (S9-mix containing rat liver homogenate (9000 g)).

The isocyanates, particularly HDI, showed a large toxic effect on the Salmonella bacteria. Mutagenicity was observed with TDI, TDA, MDI and MDA in TA 100 and TA 98 with S9-mix. In both cases the amine was more mutagenic than the analogous isocyanate. This finding suggest that the mutagenic effect of isocyanates can be attributed to reactive metabolites of the amines formed during hydrolysis of isocyanates.

1. B.N.-Ames, J. McCann and E. Yamasaki, Mutation Research, 31 (1975) 347

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