A New System (*Umu*-Test) for the Detection of Environmental Mutagens and Carcinogens Using *umuC'*-*'lacZ* Fusion Gene

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It has been suggested that damage to DNA may be a major cause of carcinogenesis. The *umu* operon in *E. coli* is involved in chemical and radiation mutagenesis, and the expression of the operon itself is inducible by these DNA-damaging agents. The principle of the *umu*-test is based on the ability of the DNA-damaging agents, most of which are potential carcinogens, to induce the *umu* operon. A plasmid (pSK1002) carrying a fused gene *umuC'*-*'lacZ* was introduced into *S. typhimurium* TA1535. The strain TA1535/pSK1002 enables us to monitor the levels of *umu* operon expression by measuring the β -galactosidase activity in the cells produced by the fusion gene. Using this strain, a simple, inexpensive and sensitive test system (*umu*-test) for screening of environmental mutagens was developed. In the present work, 38 chemicals with different modes of action and structures, including 31 known animal carcinogens, were examined by

means of this test to evaluate the system. Among the chemicals tested, 25 of the 31 known carcinogens, including 3 polycyclic hydrocarbons (3, 4-benzo (a)pyrene, 3-methylcholanthrene and 7,12-dimethylbenz(a)anthracene), 4 antitumor agents (bleomycin, doxorubicin, mitomycin C and streptozotocin) and 2 pyrolysates of tryptophan (Trp-P-1 and Trp-P-2) were detected as SOS-inducing agents while 6 carcinogens, including 2 chlorinated compounds (PCB KC-500 and *p, p'*-DDT), safrole, actinomycin D, *sym*-dimethylhydrazine and thioacetamide were not positive in this test. Five other compounds of unknown carcinogenicity, 5-fluorouracil, paraquat, 9-aminoacridine, ICR-191 and nitrosocimetidine, were detected as SOS-inducing agents. Among 2 noncarcinogens, quercetin was detected, but sodium azide was not.

The threshold sensitivity of the *umu*-test was approximately equal to that of the Ames test for chemicals genotoxic in both tests.

From these results, it is suggested that by means of the *umu*-test using the single tester strain we can detect many types of DNA-damaging agents, for which the Ames test requires several tester strains. The *umu*-test may also be advantageous for the screening of various environmental samples.