

Editorial introduction

Introduction to the Special Issue on Epigenetics

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Environmental chemicals induce various types of adverse effects such as mutation, cancer, malformation and functional disorders. In the last 40 years, they have been investigated mainly for their genotoxic and hormone-like effects. They have been categorized as mutagens, carcinogens, teratogens, and endocrine disrupters etc. according to their modes of actions. A great attention has been paid to chemicals which induce DNA or chromosomal damage until now. Such damage in somatic cells and germ cells is considered to result in cancer and malformation, and in genetic disease, respectively. On the other hand, endocrine disrupters bind to receptors such as estrogen receptor, progesterone receptor, aryl hydrocarbon receptor or thyroid hormone receptor and modulate endocrine function, which also may lead to cancer or malformation, by receptor mediated gene expression. In the last few years, environmental chemicals have been investigated on the stand point of epigenetic disturbance. This has opened up new opportunities to investigate the mechanisms underlying the mutagenesis, carcinogenesis and teratogenesis.

Epigenetics covers the study of heritable chromatin configurations (modifications) that regulate gene expression without changes in DNA sequence. Epigenetic alterations, including DNA methylation, histone modifications and chromatin configurations, can change genome function. Epigenetics is different from mutagenesis in the point of mechanism and plasticity. And it is becoming clear that epigenetics plays a role in generating individual phenotypic differences, which could affect susceptibility to disease. Recent investigations have identified a number of environmental chemicals such as cadmium, arsenic (metals), and diethylstilbestrol, bisphenol A, dioxin (endocrine-disrupting/reproductive toxicants) that cause epigenetic alteration, especially DNA methylation. However, little is known about environmental chemicals in relation to histone modifications. Other new and untested chemicals with epigenetic alterations may be distributed in our environment.

In this special issue, five articles are contained. The authors presented their recent work at the Symposium on Epigenetics of the 38th annual meeting of The

Japanese Environmental Mutagen Society organized by K. Shimoi on November 27, 2009 in Shizuoka, or at the meeting of The Research Group of Environmental Epigenetics which was established by T. Shibuya *et al.* in 2008. The first review article, by Shibuya and Horiya, addresses the importance of epigenetic disturbance in the research area of toxicology. The next two review articles, by Ohsako and by Nagao *et al.*, address effect of fetal and neonatal exposure to environmental chemicals on epigenomic modifications in offspring or on trans-generational teratogenesis. The last review article, by Kasai *et al.*, focuses on DNA methylation by various methyl radical generating system including environmental chemicals. The short communication article, by Hayatsu *et al.*, reports that the bisulfite-mediated deamination of cytosine in DNA can be performed at pH 6–7 by supplementary presence of tetramethylammonium ion. This finding will improve and expand the DNA methylation analysis technology.

Epigenetic mechanisms could be considered to be important in the future study to clarify unresolved problems underlying mutagenesis, carcinogenesis and teratogenesis induced with environmental chemicals. We hope that the articles presented here will be an interesting and may be an important clue to illuminate the relation between mutagenesis research and epigenetic research. Finally, we would like to express our sincere gratitude to the Editor-in-Chief, Dr. Minako Nagao, and Editorial Board Members of Genes and Environment for providing us this opportunity to publish this special issue.

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