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Benzo[a]pyrene and its five- and six-ring congeners contribute little or nothing to the mutagenicity of highly carcinogenic aromatic oils

It has been widely assumed that four-, five- and six-ring polycyclic aromatic compounds (PACs) mediate virtually all the mutagenicity and by correlative inference, the carcinogenicity of PAC-containing complex mixtures, whatever their source. There is abundant support for this surmise, some of it dating back to the earliest days of cancer research. But other work has called into question the importance of these compounds, which despite their potent mutagenicity and carcinogenicity when tested as individual compounds, are present in uncracked oils at concentrations far too low to account for the overall mutagenic potency of the mixture. In an effort to better understand this disparity, we have examined a series of aromatic oils, termed "distillate aromatic extracts," or DAEs, produced by furfural extraction of low viscosity vacuum distillates. We chose this petroleum stream because it is one of the most mutagenic uncracked products of petroleum refining and therefore a good candidate for a thorough cataloging of the compounds contributing to its mutagenicity. A second advantage is that DAEs are largely devoid of aliphatics, olefins and naphthenes, whose presence greatly complicates analyses of raw distillates. In the present study, dimethyl sulfoxide (DMSO) extracts prepared for mutagenicity testing in the Modified Ames Test were directly analyzed by GC-MS, or were first fractionated by HPLC and the collected fractions gas chromatographed and Modified Ames tested. The results show that nearly all the mutagenicity of the DAEs was mediated by 3- and 4-ring alkylated PACs, including polycyclic aromatic hydrocarbons (PAHs) and to some extent, their nitrogen- and sulfur-heterocyclic analogs.

Biography

Gary Blackburn is president of PetroLabs Inc., a testing and consulting firm serving the international petroleum industry. He holds a B.S. in chemistry from Wilkes University and a Ph.D. in oncology from McArdle Laboratory for Cancer Research at the University of Wisconsin. After doing postdoctoral research in the areas of radiation biology and chemical carcinogenesis, he joined Mobil Oil Corporation as a genetic toxicologist. While with Mobil, he and his colleagues developed the Modified Ames Test, the most widely used mutagenicity assay for petroleum materials. He is the author of more than 50 publications, most of which deal with the chemistry of polycyclic aromatic compounds as it relates to their mutagenic/carcinogenic potential.

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