Benzo[a]pyrene in Gasoline Partially Persists in Automobile Exhaust

Abstract. *On average 36 percent of the benzo*[a]*pyrene in an automobile's exhaust gas comes from the benzo*[a]*pyrene originally in the gasoline. Between 0.1 and 0.2 percent of the benzo*[a]*pyrene in the gasoline survives the combustion process and is recovered from the exhaust; 5 percent accumulates in the crankcase oil. Some of the benzo*[a]*pyrene in the gasoline is converted into other polynuclear aromatic hydrocarbons and other more polar compounds. For our experiments we used commercial gasoline containing benzo*[a]*pyrene at 1.0 part per million to which was added benzo*[a]*pyrene-8,9-^{14}C at 1.1 parts per million as a radioactive tracer.*

Polynuclear aromatic hydrocarbons such as benzo[*a*]pyrene (BaP) have been found in the exhaust gas from gasoline engines (*1–3*). We find these compounds in commercial gasolines also; for example, the BaP content of the gasoline used by us ranged from 1 to 2 parts per million (ppm). Since, in average city driving, some gasoline goes through the engine unburned (*4*), some of the BaP found in exhaust may derive directly from that in the gasoline.

In order to determine the contribution by BaP in gasoline to the BaP emitted in exhaust, an engine was operated on gasoline to which radioactive benzo[*a*]pyrene-8,9-^{14}C was added at 1.1 ppm as tracer. The gasoline, when purchased, contained nonradioactive BaP at 1.0 ppm, so that the total content was 2.1 ppm. The engine was relatively new; carburetion was within specifications and oil consumption was normal; it was operated on a cycle simulating city driving, and "tar" in the exhaust was recovered in a manner described (*1, 3*). The tar was analyzed for BaP and BaP-^{14}C (*5*). The results of duplicate experiments are summarized in Table 1.

Table 1. Survival in exhaust gas of benzo[*a*]pyrene; two runs. One liter of gasoline produced 8.7 m^3 of exhaust gas (wet, 24°C, 750 mm-Hg).

Benzo[*a*]pyrene		
In exhaust (μg/m^3)	From fuel: surviving combustion (%)	In exhaust: from fuel (%)
1.2	0.21	34
0.6	0.10	38

Although the percentages of BaP surviving combustion differed in the two runs, the percentages in exhaust gas, attributable to unchanged BaP from the gasoline, was approximately 36 percent in both runs; the percentage in the gasoline that survived the combustion process, to be recovered from the exhaust, was lower by at least an order of magnitude than the average percentage of unburned gasoline in exhaust gas, as has been reported (*4*).

In addition to unchanged BaP-^{14}C, the tar contained other radioactive polynuclear aromatic hydrocarbons such as pyrene-^{14}C and chrysene-^{14}C. These compounds may have resulted from the splitting of one or more benzo groups from benzo[*a*]pyrene-8,9-^{14}C, followed by molecular rearrangement, or by buildup from smaller fragments (*6*).

Although only 0.1 to 0.2 percent of the BaP in the gasoline was emitted in the exhaust, slightly more than 5 percent of the total amount in the gasoline accumulated in the crankcase oil, which also contained lesser amounts of ^{14}C in compounds ranging in polarity from alkylbenzenes (alumina column, eluted with cyclohexane) to oxygenated compounds (eluted with isopropanol).

The 36-percent contribution to the BaP in exhaust by Bap in the gasoline may be true only for the specific conditions of our experiment. Experiments with other concentrations of total BaP in gasoline, as well as other conditions of operation of the engine, are required for adequate understanding of the persistence of the polycyclics in gasoline in the total emission of these compounds from engines.

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Host Resistance Reflected in Differential Nematode Population Structures

Abstract. *Relative efficiency of host plants to support reproduction of the garlic race of* Ditylenchus dipsaci *can be partially explained by differential population structures. If axenic cultures of callus tissue from onion, white clover, red clover, and alfalfa are arranged in order of decreasing host suitability, the nematode populations are simultaneously arranged in order of increasing maleness.*

The stem and bulb nematode, *Ditylenchus dipsaci,* consists of a number of physiological races; typically each race is restricted to a limited range of susceptible hosts. However, for each race there is a spectrum of less suitable hosts which show an increasing degree of resistance (*1*).

We used techniques of axenic culture of callus tissues to explore preferentially the basis of this resistance because the undifferentiated proliferation of cells would reduce the contribution of morphological factors. Sufficient host tissues, all grown on the same medium, were present so as not to limit the growth and development of nematode populations. Callus tissues from onion; red clover, var. Kenland and var. Penscott; white clover, var. Ladino; and alfalfa, var. Caliverde and var. DuPuit were subcultured and inoculated with axenic *D. dipsaci* from three sources. These were mixed stages from onion plants, mixed stages from garlic plants, and fourth-stage larvae (preadults) from dried garlic scales. After 6 weeks at 27.5°C, the cultures were harvested, and the nematodes were recovered by means of the Baermann funnel technique. On all tissues, nematodes had penetrated, fed, developed, and moulted; and all stages appeared normally vigorous. Cultures of each tissue were replicated 20 times.

The usual ratio of adult males to