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N. Kazerouni

*National Cancer Institute, rothmann@mail.nih.gov*

R. Sinha

*National Cancer Institute, Rockville, MD*

Che-Han Hsu

*Cook College, Rutgers University, New Brunswick NJ*

A. Greenberg

*Cook College, Rutgers University, New Brunswick NJ*

N. Rothman

*National Cancer Institute, Rockville, MD*

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Research Section

# Analysis of 200 food items for benzo[*a*]pyrene and estimation of its intake in an epidemiologic study<sup>☆</sup>

N. Kazerouni<sup>a,c,\*</sup>, R. Sinha<sup>a</sup>, Che-Han Hsu<sup>b,1</sup>,  
A. Greenberg<sup>b,2</sup>, N. Rothman<sup>a</sup>

<sup>a</sup>*Division of Cancer Epidemiology and Genetics, National Cancer Institute, National Institutes of Health, Executive Plaza South, Rm 7033, 6120 Executive Blvd, Rockville, MD 20892, USA*

<sup>b</sup>*Department of Environmental Sciences, Cook College, Rutgers University, New Brunswick, NJ 08903, USA*

<sup>c</sup>*Department of Preventive Medicine and Biometrics, Uniformed Services University of the Health Sciences, 4301 Jones Bridge Road, Bethesda, MD 20814-4799, USA*

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## Abstract

Animal studies have shown that dietary intake of benzo[*a*]pyrene (BaP), a polycyclic aromatic hydrocarbon (PAH), causes increased levels of tumors at several sites, particularly in the upper gastrointestinal tract. However, the role of dietary intake of BaP and cancer in humans is not clear. We created a BaP database of selected food products that could be linked to Food Frequency Questionnaires (FFQs) to estimate BaP intake. BaP levels were measured for each food line-item (composite samples) which consisted of a variety of foods in a FFQ. Composite sample parts were derived from the Second National Health and Nutrition Examination Survey (NHANES II) which represents the most common food items consumed by the general population. Meat samples were cooked by different techniques in controlled conditions, and by various restaurants and fast-food chains. Non-meat products were purchased from the major national supermarket chains. The quantities of BaP were measured using a thin-layer chromatography (TLC)/spectrofluorometer technique and were highly correlated with both BaP (radius=0.99) and sum of carcinogenic PAH ( $r=0.98$ ) measured by HPLC technique. We linked our database to the results from a FFQ and estimated the daily BaP intake of various food items in 228 subjects in the Washington, DC metropolitan area. The highest levels of BaP (up to about 4 ng BaP/g of cooked meat) were found in grilled/barbecued very well done steaks and hamburgers and in grilled/barbecued well done chicken with skin. BaP concentrations were lower in meats that were grilled/barbecued to medium done and in all broiled or pan-fried meat samples regardless of doneness level. The BaP levels in non-meat items were generally low. However, certain cereals and greens (e.g. kale, collard greens) had levels up to 0.5 ng/g. In our population, the bread/cereal/grain, and grilled/barbecued meat, respectively, contributed 29 and 21 percent to the mean daily intake of BaP. This database may be helpful in initial attempts to assess dietary BaP exposures in studies of cancer etiology. Published by Elsevier Science Ltd.

**Keywords:** Polycyclic aromatic hydrocarbons; Benzo[*a*]pyrene; Meat; Pork; Chicken; Seafood; Vegetables; Fruit; Grains; Fat; Sweets; Pan-fry; Oven-broil; Grill; Barbecue; Carcinogenic; Food frequency questionnaire; Cancer

**Abbreviations:** BaP, benzo[*a*]pyrene; FFQ, Food Frequency Questionnaire; HCA, heterocyclic amine(s); PAH, polycyclic aromatic hydrocarbon(s); HHHQ, Health Habits and History Questionnaire; ng, nanogram; NHANES II, Second National Health and Nutrition Examination Survey; TLC, thin layer chromatography; THEES, Total Human Exposure to Environmental Substances.

<sup>☆</sup> The opinions or assertions contained herein are the private ones of the author and are not to be construed as official or reflecting the views of the United States Department of Defense or the Uniformed Services University of the Health Sciences.

\* Corresponding author. Tel.: +1301-594-7296; fax: +1301-496-1854.

E-mail address: kazeroun@exchange.nih.gov (N. Kazerouni).

<sup>1</sup> Current address: Department of Hospital and Health Care Administration, Chung-Tai Institute of Health Sciences and Technology, 11, Po-tze Lane, Takun, Taichung, 40605, Taiwan, ROC.

<sup>2</sup> Current address: Department of Chemistry, University of New Hampshire, Durham, NH 03824, USA.