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Evaluation of Human Health Associated With Environmental Risk

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ABSTRACT

The aim of this paper is to understand the adverse health effects associated with food, water and air. Environmental risk can produced adverse health effects among large number of people. Humankind has always faced certain dangers. Risk is an incapable fact of life. However enlightened societies have traditionally sought to minimize avoidable risks. The foods and water are so complex and variable in composition, health risks associated with them can be understood only through the continued pursuit of long term epidemiological investigations. There seems little doubt that about the composition of the human diet strongly influences health status, in both positive and negative ways. The concentrations of chemicals in water supplies depend greatly on source of water and its treatment history. As global trade in basic food commodities continue to increase, so will adverse health impacts spread. Contamination by human pathogens is a significant problem even in developed countries. On a global scale the most significant acute health problem associated with food. Surface water from unprotected watersheds generally has low concentrations of both dissolved minerals and environmental chemicals. Well waters have low concentrations of bacteria and environmental chemicals but often have high mineral concentrations. Poor waste disposal practice may contribute to ground water contamination. Treated surface waters from lakes and rivers in densely populated or industrial areas usually contain a wide variety of dissolved organics and traced metals, the concentrations of which vary greatly with season. Exposure of airborne chemicals vary widely among inhalation environment, The categories include workplace, residence, outdoor ambient air, transportation and public spaces. An exposures airborne chemical varies in terms of composition and concentration. Effective monitoring and exposure control strategies should be in place to achieve exposure results that do not result in adverse changes in health parameters and risk assessment; it can also be used to measure and compare the benefits of possible options concerning the problem of understanding health-environmental risks..

INTRODUCTION

Environmental risks have been changed overtime. A risk assessment provides information to policy makers, regulatory agencies, and other risk managers and to the public so that the most appropriate decisions can be made. A risk assessment puts the words toxicity, hazard, and risk into perspective. Risk assessment is defined as the characterization of potential adverse health effects of human exposure to environmental hazards; the assessment includes the characterization of the uncertainties inherent in the process of inferring risk. The risk assessment process can be divided into four major steps: hazard identification, exposure assessment, dose-response assessment, and risk characterization (NAS, 1994). Risk assessment is then followed by risk management if the estimated risk is indicated to be unacceptable. Risk management defined as the process of evaluating alternative regulatory actions and selecting among them; the selection procedures requires the use of value judgments on such issues as the acceptability of risk and the reasonableness of the costs of control. The values of risk assessment process are many. An important value is that it provides consistent, disciplined approach to organize scientific information so that the relevant items are considered and used for subsequent risk management decisions. The risk assessment provides helps identify the uncertainties involved in the data, and the assumptions that are involved. It helps to indicate the time frame involved, and who or what is affected. It helps identify strategies and priorities such as where in the process risk management decisions

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can be most effective. It also helps educate all involved factors, exposures, effects, and relative risks that exist at a site or for a particular situation. The concepts of risk-based corrective action and risk-based decision making are being widely applied to identify appropriate risk management decisions that should be considered at specific sites to protect human health and the environment. The following example may help put the use of the risk assessment process for environmental decision making into perspective. A simplistic risk assessment paradigm is shown in **Figure 1**.

RESULTS AND DISCUSSION

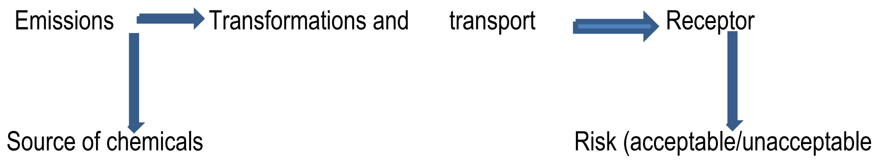

Figure 1. Conceptual risk assessment paradigm.

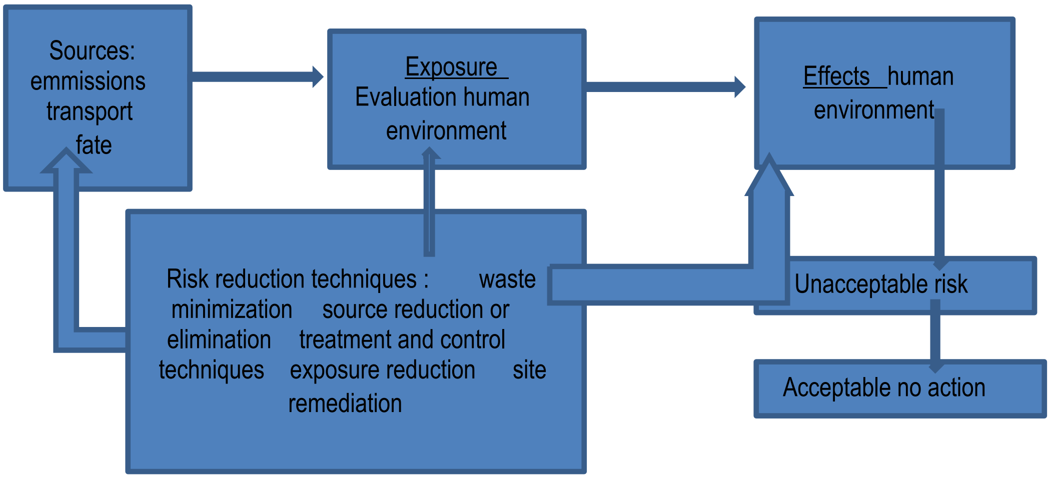

Figure 2. Illustrative engineering risk management approaches.

For a situation to pose threat to human health and the environment there must be a source of contamination. Then, one or more chemicals must be released from the source. Once released, the chemicals may be transported to a receptor of concern such as human, plant, or fish. During the transport, there may be transformation that can change the form or speciation of the chemical, which in turn may make the chemical more or less mobile or toxic. If the chemical is able to contact a sensitive area of a receptor, that is if exposure occurs, there could be a negative impact **(Figure 2)**.

The Problem of Understanding Food Related Health Risks

Food is by far the most chemically complex part of the environment to which humans are chemically exposed. We have no reliable estimate of the number of distinct chemical compounds in the different items of food and drink we select for nourishment and pleasure **(Table 1)**.

Table 1. Classes of food constituents and contaminants and their known and potential health impacts.

Class	Description	Methods used to Study Risks and Benefits	Importance and Source of Health Risks	Known and Possible Health Benefits
Nutrients	Macronutrients (Supply energy) and micro nutrients.	Clinical/epidemiological. Major challenge to develop experimental models to study excessive intakes.	Major Excessive energy, saturated fat intake; abusive intakes may be significant for some micronutrients.	Major Essential for life. Levels in excess of recommended intake levels may prove to be beneficial.
Natural, non-nutritive constituents	Largest and chemically most diverse class	Little systematic study, mostly experimental.	Insufficient knowledge. A reasonable conjecture is that they are at least moderately important.	Insufficient knowledge. Some appear to offer benefits, and many may prove to be beneficial.

Intentionally induced substances, direct and indirect	Food additives, GRAS substances. Pesticides, veterinary drugs, feed additives.	Experimental study well developed. Little epidemiological study.	Minor/moderate Many substances introduced decades ago, have not been studied using current experimental methods. Cumulative effects unknown.	Minor Some may provide benefits through pathogens reduction, preservation of foods.
Chemically produced during processing, preparation	Reaction products from heating, irradiation, etc. Chemically very diverse.	Little systematic study, mostly experimental.	Insufficient knowledge A reasonable conjecture is that they are of minor but not negligible importance.	Insufficient knowledge Not expected to confer significant benefits
Contaminants	Substances permitted under law to be sold as supplements.	Several contaminants very well studied, many not. Epidemiological experimental.	Moderate Pathogens produce largest number of countable cases of food-related illness; most not serious or irreversible. Persistent, bio accumulative chemicals are or concern.	Insufficient knowledge. Not expected to confer benefits.
Dietary supplements	Substance permitted under law to be sold as supplements	Little systematic study. Epidemiological/clinical, experimental all applicable.	Insufficient knowledge. Reasonable conjecture not possible. Little systematic study.	Insufficient knowledge Many perceived as beneficial. Little systematic study, but increasing.
Alcoholic beverages	Ethanol plus many fermentation products	Epidemiological studies extensive.	Major Abusive intake associated with mortality and morbidity	Moderate Range of low intakes almost certain to decrease risk of CHD.

Food chemist will not know the small fraction of the chemicals we deliberately put into our mouths everyday of our lives (NRC). The natural constituents of foods and beverages represent the major share of dietary chemicals which contains flavour and colour. For example, freshly brewed cup of coffee contains more than 600 distinct compounds and the additional burden of natural products from the hundreds of herbs and spices used in food preparation [1]. Fermentation produces numerous chemical alterations of organic compounds, yielding products bearing little chemical similarity to the starting materials. Little scientific skill, and not much gastronomic skill, is needed to recognize that each variety of wine, cheese, fruit juice or milk possesses a unique chemical composition. Roasting, broiling, baking, smoking, and other means of preparing foods each have its own chemical reaction.

Drinking Water Disinfection By-Products

The disinfection of drinking water brings competing health concerns more sharply into focus than most other environmental problems **(Table 2)**. Waterborne disease was common in the United States before the introduction of disinfection [2]. The introduction of chlorination and other improvements in drinking water treatment, particularly filtration, contributed to very sharp decline deaths from cholera, typhoid and a variety of other infectious diseases.

Table 2. Power of alternative drinking water disinfectants.

Disinfectants	Oxidation Potential, at 250°C, Vb	Relative Oxidation power	Effectiveness as a Disinfectant
Hydroxyl radical	2.80	2.05	
Ozone	2.07	1.52	High
Hydrogen peroxide	1.77	1.30	Moderate
Hypochlorous acid	1.49	1.10	High
Chlorine	1.36	1.00	High
Hypobromous acid (bromine)	1.33	0.98	High
Chlorine dioxide	1.275	0.94	High
Monochloramine	1,16	0.85	Low High
Hypoiodous acid (iodine)	0.99	0.73	High

Note: Source: Relative to the hydrogen electrode, Relative to chlorine= 1.0 [3]

Waterborne infectious disease does still occur and its occurrence is most frequently associated with inadequate disinfection, example is equipment failure or water plant error [4]. Epidemic infectious diseases in large cities might well be attributed to well design and maintained urban water systems although it is difficult to quantitatively estimate the impact of suspending the use of disinfectants in drinking water. Disinfection of drinking water is a well-established and effective means of preventing pathogenic organisms from being transmitted through public water supplies. There are actually two points where disinfectants are added. The first is made early in the treatment process, with the intent of inactivating all pathogens microbes and viruses that might contaminant the source water and is referred to as primary disinfection. In most water supplies there is a second addition of

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disinfectants as the water leaves the treatment plant in the distribution process. These additions are referred to as post or secondary disinfection. The intent to reduce colonization of water distribution system and to minimize the impact of sources of contamination in the system and this involve the successive additions of the same disinfectants or utilize different disinfectants in each of the locations to minimize operational issues as well as by-products formation.

Ambient Air Particulate Matter

A broad variety of processes produce suspended particulate matter (PM) the ambient air in which we live and breathe, and there is extensive body of epidemiological literature that demonstrate that there are statistically significant associations between the concentrations of airborne PM and the rates of mortality and morbidity in human populations. The PM concentrations have almost been expressed in terms of mass, although recent studies suggest that number concentration may correlate better with some effects than does mass [5,6]. As indicated in **Table 3**, fine and coarse particles generally have distinct sources and formation mechanisms, although there may be some overlap. Primary fine particles are formed from condensation of high temperature vapors during combustion. Secondary fine particles are usually formed from gases in three ways: 1) Nucleation (gas molecules coming together to form a new particle); 2) condensation of gases onto existing particles; and 3) by reaction of absorbed gases in liquid droplets. Particles formed by nucleation also 0.1 and 1.0 µm, and such particles normally do not grow into the coarse mode.

Table 3. Components of ambient air PM that may account for some or all of the effects associated with PM exposures.

Components	Evidence for role in Effects	Doubts
Strong acid (H^+)	Statistical associations with health effects in most recent studies for which ambient H^+ concentrations were measured. Coherent responses for some health end points in human and animal inhalation and *in vitro* studies at environmentally relevant doses.	Similar PM associated effects observed in locations with low ambient H^+ levels. Very limited data base on ambient concentrations.
Ultrafine particles (D ≤ 0.2 µm)	Much greater potency per unit mass in animal inhalation studies (H+, Teflon, and T_1O_2 aerosols) than same materials in larger diameter fine particle aerosols. Concept of “irritating signaling” in terms of number of particles per unit airway surface.	Absence of relevant data base on ambient concentrations.
Soluble transition metals	Recent animal study evidence of capability to induce lung inflammation.	Absence of relevant data on responses in humans. Absence of relevant data on ambient concentrations.
Peroxides	Close association in ambient air with SO_4 = Strong oxidizing properties.	Absence of relevant data on response in humans or animals. Very limited database on ambient concentrations.

Particles formed have a low enough vapour pressure to form a particle or react further to form a low vapour sulfuric acid droplets (H_2SO_4); 2) Reactions of H_2SO_4 with ammonia (NH_3) to form nitrogen bisulphate (NH_4HSO_4) and ammonium sulphate $(NH_4)_2SO_4$; 3) the conversion of nitrogen dioxide (NO_2) to nitric acid vapour (HNO_3), which reacts further with NH_3 to form semi volatile particulate ammonium nitrate (NH_4NO_3). Although directly emitted particles are found in the fine fraction, particles formed secondarily from gases generally dominate the fine fraction mass. Most of the coarse fraction particles are emitted directly as particles, and result from mechanical disruption such as crushing, grinding, evaporation of sprays, or suspensions of dust from construction and agriculture operations. Most coarse are formed by breaking up bigger masses into smaller masses. Energy considerations normally limit the coarse particles sizes to greater than 1.0 µm in diameter. Some combustion generated particles, such as fly ash, are also found in the coarse fraction. Fine and coarse particles exhibit different degrees of solubility and acidity. With the exception of carbon and some other organic compounds, fine particles mass is largely soluble in water and hygroscopic (fine particles readily take up and retain water). Except under fog conditions, the fine particle mode also contains all the strong acid. Fine and coarse particles typically exhibit different behaviour in the atmosphere. The behaviours of particles that were formed outdoors after they penetrate In residential area and buildings where people spend most of their time. Fine accumulation mode particles typically have longer atmospheric lifetimes than coarse particles, and tend to be more uniformly dispersed across an urban area or large geographical region. Large particles generally deposit more rapidly than small particles; as a result, total coarse particle mass will be less uniform in concentration across a region than a fine particle. Because coarse particles may vary in size from about 1 µm to over 100 µm, it is important to note their wide range of atmospheric behaviour characteristics. Large coarse particles (>10 µm) tend to fall out of the air and have atmospheric lifetime of only minutes to hours depending on the size, wind velocity, and other factors. More people are dying of cardiopulmonary causes on a given day because of exposure to elevated concentrations of PM, It would be reasonable to expect higher daily rates of emergency hospital admissions and visits to emergency rooms and clinics for similar causes. This expectation is consistent with the results summarized in the latest PM criteria Document [7]. Another aspect is the influence of PM on short term mortality is its role in sudden infants' death syndrome (SIDS). Woodruff et al. examine the relationship between post neonatal infant mortality (28days to 1year) and PM10 in the

United States [8]. Loomis et al. reported 18.2% excess in infant mortality per 25 μg/m³ [9]. Boback and Leon reported the long term exposure to PM for the whole Czech Republic was associated with excess neonatal and post neonatal deaths [10]. Ritz et al. studied the association between pollutant exposures and low birth weight (LWB) IN 95, 518 neonates in Southern California, after adjustment for maternal age, race, smoking during pregnancy, etc. A 50 μg/m³ increase in PM10 exposure average over the first month of pregnancy was associated with a 16% increase in preterm delivery, while a 50 μg/m³ increase in PM10 exposure, average over the 6 weeks prior to birth, was associated with a 20% increase [11]. However, a study by Maisonnet et al. of the association between LBW and PM10 in eastern U.S. cities was negative [12-14].

CONCLUSION

Effective monitoring and exposure control strategies should be in place to achieve exposure results that do not result in adverse changes in health parameters. Health surveillance programs can provide insight on the effectiveness of control strategies in addition to their purposes. Environmental Engineers must understand the limits of existing technologies. The sciences of risk assessments can be used to measure and compare the benefits of possible options concerning the problem of understanding health- environmental risks. The tools available to study risks of food are seriously limited. Certain epidemiologists have been able to provide some highly important clues about health benefits and risk associated with certain nutritional characteristics of the diet, but so far have been able to say much about the possible risk of thousands constituents and contaminants which may confer substantial health benefits. Also evidence show that there may be some adverse health impacts associated with the use of chemical disinfectants continues to grow. It is important that the chemicals causing this health effects in drinking water be identified, not simply to satisfy scientific curiosity, but to find the alternatives that reduce or eliminate the risk. There should be a need to be more organized efforts to identifying the potential hazards that be uniquely associated with each disinfectants considered for broad application. Excess daily mortality and morbidity have been related to ambient PM at current levels in many communities and around the world using available pollutant concentration data. It is essential to evaluate the effectiveness of public health outreach and involvement efforts associated with environmental risk, as they are being implemented and after the process is complete. This provides correction and improvement, both as the process advances in the future efforts.

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