# ENVIRONMENT BORNE CHEMICAL CONTAMINANTS IN MILK - A PERTINENT THREAT TO CONSUMERS

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### Introduction

The ultimate ground for agricultural food production is the local environment that is very much vulnerable to regional and even global influences on its specific conditions. Population growth, industrial growth and technological development has an insidious effect on chemical contamination of the environment The chemicals released into the environment by human activities cause ecological injury usually far away from their original sources, especially when they gain entry into food chain. Milk production may be considered as a highly sensitive food delivering ecosystem in the environment. Foods of animal origin depend unconditionally on feed, and feed production on the local environment. Environment borne chemical contaminants enter the food chain via the animal feed. Food production detached from environment cannot be thought of. The inevitable utilization of environment for food and feed production and the use and misuse of environment for all economic activities including waste disposal imply many conflicts on the health of consumers.

The environment based feed and food production is a very complex web. Milk is close to the end of food chain in this complex web. Hazards in the milk production environment are numerous and more difficult to be controlled Awareness on the different chemical contaminants and their impact on food production will be helpful to control the adverse effects of environment on food production.

### Carry-over contaminants

Along with the major and minor nutrients, dairy cow ration contain varying amounts of undesirable chemicals too from the environment. After ingestion, animals excrete these chemicals in traces along with milk. This phenomenon called carry-over depends on chemical nature of the

compound and their ability to pass blood milk barrier. The carry-over mechanism is important in the field of food safety, as this links the 'environment' represented by fodder/feed to milk.

The environmental contaminants in milk can either be of secretoric or post-secretoric origin. The latter is a simple dissolution process when milk comes in contact with the substances of concern and is of relevance in milk products under storage. The classic pathway comprises of ingestion by the animal, passage through blood milk barrier and appearance in milk. The individual carry-over rates after ingestion depend on the physiology of animal, bioavailability of the compound, its chemical stability, the amount taken up, intensity and frequency of exposure. Generally, lipophilic and environmentally stable contaminants show the highest carry over rates.

# Hazardous environmental contaminants in food

The environmental contaminants are a group of substances with diverse chemical structures. These substances are stable and thus are persistent in the environment; they tend to accumulate in the food chain and can be transformed to more toxic forms. To control environmental pollution and protect humans and animals from environmental hazards, it is good to be aware of Persistent Organic Pollutants (POPs). According to UNEP, 1998 those with the following properties are identified as POP's.

♦ POPs are very stable and can persist in the environment for years or decades.

◆ They can circulate globally through a process called 'grass hopper effect'. POPs released from one part of the world can be transported through the atmosphere to regions far away from the original source by a repeated process of evaporation and deposition.

• POPs accumulate through the food web

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JIVA 7(2):2009

and bioconcentrate in living organisms by getting deposited in fatty tissues, wherein concentration gets magnified later.

• They are highly toxic and can cause an array of immediate adverse effects like allergy and delayed effects like damage to nervous system, reproductive disorders disruption of the immune system and cancer.

Globally banned organic pollutants (UNEP, 1998) were i) *pesticides*: Aldrin, Chlordane, Endrin, Dichlorodiphenyltrichloroethane (DDT), Dieldrin, Heptachlor, Hexachlorobenzene, Mirex, Toxaphene and ii) *Industrial toxins/ by-products*: Polychlorinated biphenyls (PCBs), Furans, Dioxins

For a chemical contaminant to accumulate in food chain,

§ It should have a high octanol-water partition coefficient

§ It should be stable in water and other compartments of aquatic system.

§ It should be metabolically stable in the species involved.

§ Its toxicity is comparatively low in the sense that they are not eliminated in the intermediate species breaking the food chain.

## Hazards in Animal feed

Hazards in feed may be physical, chemical or biological. When environment borne contaminants in 'foods' are considered, most relevant ones are 'residues'. Environmental contamination with chemicals could occur by two ways; either a long-term low level contamination resulting from a gradual diffusion of persistent chemicals through environment or a short-term high level contamination resulting from an accidental or inadvertent release of chemical/active by-product/ waste product into the environment. Important environmental contaminants in the farm surroundings include agricultural chemicals like pesticides.

Pesticides include insecticides, herbicides and fungicides. The most commonly used insecticides are organochlorines, organophosphates and carbamates. The organochlorine compounds enter the food chain as

a result of their lipophilic properties. The main route of human exposure to organochlorine pesticides is through foods of animal origin, of which milk is the most important product. Milk is considered as a convenient indicator of persistent residues in animal feed. The dioxin group of chemicals include 2,3,7,8tetrachlorodibenzo-p-dioxin (TCDD), polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated dibenzo furans (PCDF's) and some coplanar compounds of Polychlorinated biphenyls(PCBs). Dioxins and PCBs are formed during the production of chloro-organics. Industrial emissions, municipal incineration and pyrolysis processes also add PCBs to environment. Contamination of animal feed occurs via particle bound distribution on grass and fodder. Human foods of animal origin contribute to 80% of overall human exposure to dioxins. Polynuclear aromatic hydrocarbons (PnAHs) are produced during combustion and are common in diesel and gasoline exhaust, where incomplete combustion of fuel occurs. The fall-out of PnAHs on crops from combustion processes causes the contamination of food supplies. Approximately 80% of total dietary intake of PnAHs comes from cereals and oils/fats food group.

Radionucleides are deposited by rain and thus find their way to human and animal food supply. Some some crops like mushrooms can concentrate radionucleides. In grass, contamination is by simple deposition. Milk is often used as an indicator for detection of radionucleides.

## Heavy metals

The term 'heavy metals' is a general term that applies to a group of metals and metalloids with an atomic density greater than 6 g/cm<sup>3</sup>. The term includes elements like Chromium, Nickel, Copper, Zinc, Magnesium, Cadmium and lead. Most of the significant environmental contamination problems are the result of mining, irrigation and energy extraction which lead to accumulation of naturally occurring substances in harmful concentrations. Cadmium, lead and mercury are the toxic trace metals of significance to man and are a threat to our food stuffs by virtue of their industrial usage. Plants grown in soil with high concentrations of heavy metals can accumulate Beena A.K. and Geevarghese P.I.

Heavy metal	Source (origin)	Food contaminated
Elemental mercury and salts	Geological	Fish
Arsenic – various chemical forms	Geological	Soft drinks, fish, health food supplements
Selenium	Seleniferous soils	Grains
Cadmium	Geological	Fishery products
Tin	Geological	Fish

Table 1: Major Heavy Metal Contaminants of Natural Origin, (Munro and Charbonneau, 1981).

heavy metals. Animals ingesting these plants pass it over to the consumers of animal products. Most of the elements included in this category are used extensively in electronics, machines, and other high tech applications.

The most common metal pollutant is lead. Cigarette smoking, cosmetics and exhaust fumes from vehicles increase exposure to lead. The adverse effects of lead include interference to the cognitive brain function in children. It also affects kidney and haematopoietic system. Mineral supplements may have high concentrations of Nickel, lead, Cadmium and Chromium. Reports indicate that many dairy cattle feed contain zinc and copper in exceedingly high concentrations. The major heavy metal contaminants of natural origin is given in Table 1.

# **Control measures**

Control measures mainly focus on the slogan 'Feed for Food'. The statement emphasizes the crucial role of animal feed industry in assuring safe livestock products. Safe and wholesome feed and feed ingredients are essential to guarantee quality milk. In minimizing the risk of milk contamination, feed production should be seen as the integral part of milk production. The safety of milk is then the result of continuum of control measures applied throughout the food chain. Following Good Agricultural Practices (GAP), minimize the entry of physical chemical and biological contaminants into the food chain. Good manufacturing practices are to be followed during processing, storage and distribution of feed and feed ingredients. Good animal feeding practices are equally important to

assure quality livestock products which include regular monitoring of drinking water quality, prompt supervision of grazing rotations to minimize cross contamination from manure/ agricultural chemicals and appropriate documentation of all the procedures followed. Application of HACCP (Hazard Analysis Critical Control Points) principles will further improve the effectiveness of good codes of practices. Initiatives for risk assessment in children and infants- the most vulnerable sectors in the society are urgently needed to protect them from disproportionately greater risks to these hazards of environmental origin.

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