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*Review Article*

# Antioxidant Micronutrients as Intersectoral Link between Health and Agriculture

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## *ABSTRACT*

*Environmental and ecological disorders and the attendant health problems especially cancer and heart diseases are a major concern currently. Although cancer is perhaps the most feared and best known of the chronic pathologic effects of environmental pollution, it should be recognized that environmental agents especially heavy metals, such as lead and cadmium, may also cause behavioural abnormality which can lead to increase in crime rate. Antioxidant micronutrients are protective against these dreaded disorders. Environmental problems extend beyond the boundaries of the traditional confines of the health sector. It also affects the agricultural sector and this sector may also have an ameliorative influence on the degree of environmental and ecological disorders. This report emphases the need for the two major sectors, health and agriculture to evolve ways of checking the deleterious effects. Increase consumption of antioxidant micronutrients available in fruit and vegetables namely vitamins A, B, C, and E, β-carotene and selenium should be consistently recommended by the health sector to reduce the toxic effects of environmental pollutants. This report draws attention to environmental and ecological disorders and emphasizes the needs not to treat them in isolation but that they are inseparable. These disorders will be examined in conceptual and programmatic terms. Intersectoral collaboration between the agricultural and health sectors appears desirable by helping to prevent disease, promoting health and improving the quality of life by means of antioxidant micronutrients. The role of the agricultural sector in this regard should be to increase the production of these crops to make them readily available at low cost in Nigeria. This intersectoral collaboration is required for sustainable development of which health should be a goal* ***(Afr. J. Biomed. Res. 9:1 – 10, January 2006)***

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## INTRODUCTION

There is growing concern about the ill effects of environmental pollution, not only on human health, but on all living things (Last, 1987, Oyesola, 1998). This impinges on environmental health. Environmental health is the aspect of public health concerned with all the factors, circumstances and conditions in the environment or surroundings of humans that can exert an influence on human health and well beings (Last, 1987). It is thus clear that environmental health extends beyond the boundaries of the traditional confines of the health sector. It focuses the mind on the World Health Organization's (WHO) current approach to health which calls for the need for intersectoral collaborations (WHO, 1997a).

Heavy metals, particularly ARSENIC, cadmium, mercury and lead are important environmental pollutants threatening the health of human populations and natural ecosystem alike (Mercier and Pinnavaia (1998). Most cases of heavy metal poisoning result from chronic low level exposure to these hazardous environmental toxins. Removal of these toxins from the environment is not possible and they contribute to disease states particularly cancer (Carson, 2002, Peraza et al, 1998). The ecology of the human body, the concept that human health would ultimately reflect the environment's ills or disorders is poorly recognized.

The combination of population pressure, malnutrition and infection has sapped the vitality of developing nations for generations. Now, new problems are being added. Industrial development, often without the restraining laws and regulations of the affluent technologically advanced nations is causing serious environmental and occupational diseases (Last, WHO 1992). Clearly the ecosystems as we know them can not be maintained, nor will health or quality of life for the majority of human beings be improved with continuous environmental and ecological disturbances.

Over the past five decades, the threats to health of humans and plants from these rapidly changing physical and social environmental conditions have increased at an unprecedented rate and as a result ecological and environmental issues have assumed the centre stage in global political issue (Oyesola, 1998). It has also become the concern of environmentalists and non-environmentalists alike.

Shakman (1974) discussed the influence of nutritional factors on environmental pollution. He observed that mankind currently live in an environment in which many kinds of pollution and ecological disorders are serious problems and appropriate food supplies are inadequate. Additionally, there is an emerging concept of health, in which health is seen as an essential component of sustainable development which can only be achieved through concerted action by several sectors (WHO, 1997b). A closer partnership between the health and the agricultural sector is required to reduce the threat resulting from environmental and ecological disorders. In today's industrial society, there is no escaping exposure to toxic chemicals and metals. In the more severe cases of heavy metal toxicity, treatment should be nutritional, which works slowly but efficiently and safely.

At the beginning of a new century it has become of critical importance for the two major sectors, health and agriculture to evolve mechanisms to stem the deleterious effects of environmental and ecological disorders. This need for a collaborative intersectoral approach in handling these disorders is not sufficiently recognized generally and in developing countries in particular. This report therefore draws attention to environmental and ecological disorders and emphasizes the need not to treat them in isolation but that they are inseparable. Environmental and ecological disorders will be examined in conceptual and pragmatic terms. Intersectoral collaboration between the agricultural and health sectors appears desirable by helping to prevent disease, promoting health and improving the quality of life by means of antioxidant micronutrients.

### Sustainable Development and Health

The key concept underlying the new strategy to environmental health in relation to environmental and ecological disorders was the new perspective of health that has emerged whereby health was seen as an essential component of sustainable development (WHO, 1997b). Sustainable development is defined as "a process of change in which the exploitation of resources, the direction of investment, the orientation of technological development and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations" (WHO, 1997b).

Health may be safe guarded by employing the principles of nutritional medicine (Tolonen, 1990). Health should not be considered just as the absence of disease but also as a central goal of human development. Consequently, the protection of the environment as well as the protection and improvement of health become mutually supportive. The triad of health, environment and development should always be considered and their interdependence underlined.

### Environmental and Ecological Disorders And Their Effects

In 1996, it was reported that poisonous waste from a zinc mine jointly owned by a British-based multinational and the World Bank caused one of the worst

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environmental disasters ever to strike Latin America (Edward, 1966). Similar occurrences exist in the Niger Delta of Nigeria (Oyesola, 1995, 1998). Nigeria's environmental problem caused by petrochemical activities in the last forty years is almost of a similar magnitude. The Nigerian oil industry is engaged in joint venture with several multinational oil companies, including Shell (UK/Netherlands), Chevron (USA) and Elf (France). In the past few years, they have been heavily criticized for environmental pollution.

According to European environmentalists investigating the Latin America disaster, this big pollution accident led to release of iron sulphide (FeS), Lead (Pb), Cadmium (Cd), Arsenic As) and other. These are heavy metals which increases free radical generation and attendant oxidative stress.

The deleterious health effects of this large pollution can be mitigated by increased antioxidant micronutrients consumption (Peraza et al. 1998), which come largely from fruit and vegetables. (RRI, 1995).

**Aluminium**

Exposure to aluminium in the environment is high because it is the most abundant metal in the Earth's Ocust. In the form of $Al^{3+}$ it is highly toxic especially to the brain. Fortunately, aluminium is not always present in this toxic form but usually in the relatively nontoxic inorganaic complexes.

The most controversial aspect of aluminium toxicity is its role in the aetiology human neurodegenerative diseases. Speculations about a relationship between aluminium neurotoxicity and Alzheimer's disease has resulted from several observations. A geographical relationship between Alzheimer's disease and aluminium in drinking water from environmental pollution owing to increased industrial utilization has been reported (Martyn et al, 1989). Some of the most complelling evidence to implicate aluminum as an environmental toxin in the pathogenesis of Alzheimer's disease is derived from the study of Crapper-McLachlan et al (1991) who showed that intramuscular administration of desferrioxamine may slow the clinical progression of the dementia associated with Alzheimer's disease. Desferriioxamine is a trivalent ion-specific chelating agent with a high affinity for both ferric and aluminium ions. Desferroxiamine has been used extensively to treat clinical toxicity attributable to these metals. The study of Crapper-McLachlan et al 1991 has shown that desferrioxamine therapy led to a significant reduction in the rate of decline of daily living skills.

A recent study has shown that antioxidant micronutrients also have therapeutic implications for this neurodegenerative disease (Haliwell, 2001). This suggests that optimum levels of micronutrient antioxidant may have a preventive role as well as a modulating role in this significant environmentally induced neurodegenerative disorder.

Lead another prime environmental pollutant is a multi organ poison which in addition to the well known toxic effects depresses the immune status (Anetor and Adeniyi, (1998)). Mercury is a well known neurotoxin which is also known to lower immune status and cause alternation in the balance of subtypes of immune cells leading to increased susceptibility to malaria and autoimmune diseases (Kaiser, 1998). Antioxidant micronutrients are known to ameliorate this adverse health outcome (Tolonin, 1990). Since the nuclear accident of Chernobyl in Ukraine occurred in 1986, there has been a sharp increase in thyroid cancer among children from affected areas. By the end of 1995, about 800 cases in children under 15 years of age had been diagnosed mainly in the northern regions of Ukraine and Belarus.

The radioactive contamination of the vast areas unfortunately impeded normal industrial and agricultural production. But unaffected neighbouring area can provide the agricultural support required to combat the attendant environmental and ecological disorder associated health effects.

**Crime Rates and Pollution**

A recent intriguing observation is that environmental pollution may have a big contribution to violent crime and antisocial behaviour (Motluk, 1997). In this report toxic chemicals, in particular metals in water supplies, can disrupt the neurological control mechanisms that normally inhibit violent tendencies. Conventional theories link crime with social, economic and psychological factors. These recent findings suggest that these may only be contributory. Some investigators believe that conventional factors cannot fully explain why some places in the United States have only 100 violet crimes per 100,000 people each year, while others have 3000 people each year. Data on environmental pollution are thought to account for the remaining variations (Motluk, 1997, Needleman et al, 1996).

The proponents of this view have analysed a wide range of statistics including crime figures from the American Federal Bureau of Investigation (FBI) and information on industrial discharges of lead and other pollutants, both into the water and into the atmosphere from evidence accumulated by the United States Environmental Protection Agency (EPA). After excluding confounding variables such as income and population density, it was discovered that environmental pollution seems to have an independent effect on the rate of violent crimes (Motluk, 1997). Crime was defined in

this study as the number of homicides, aggravated assaults, sexual assault and robbery. The latter of which is a current major concern in this country (Nigeria).

Regions with the highest levels of lead and other environmental pollutants, typically have been shown to have crime rates three times the national average. The presence of pollution has been described as big a factor as poverty (Motluk, 1997). The mechanism for this appears to be that when neurochemical processes are altered by exposure to neurotoxic metals such as lead and mercury, natural violent tendencies may no longer be restrained (inhibited). It is thought that it is this break down of the inhibition mechanism that underlies violent behaviour (Motluk, 1997). The proponents point to experiments on cell cultures which support the fact that lead partly incapacitate glial cells, which are responsible for cleaning up (house keeping) such as in the brain undesirable chemicals (Young, 1994). Similarly in people suffering from calcium deficiency which afflicts many poor populations of the world, environmental pollutants inhibit the uptake of neuro transmitters, serotonin and dopamine in parts of the brain. These chemicals play a role in modulating impulsive behaviour. The proponents of this hypothesis think that a major source of lead and other environmental pollutants may be potable water (Adeniyi and Anetor, 1999), owing to the variable sources of potable water in this environment. Soils contaminated with lead and other atmospheric pollutants are believed to also contribute. The Nigerian environment is also heavily polluted (Okoye, 1994, Udousoro and Osibanjo, 1997). While these claims are yet to be consistently confirmed the likelihood of their correctness is quite high. It is desirable to repeat similar studies in industrial cities like Lagos, Port Harcourt and Warri in Nigeria. Could the degree of environment pollution in these cities contribute to the high crime rates in these cities?

Consumption of increased amounts of micronutrients appears a pragmatic way out (Mahaffey and Vanderveen 1979; Peraza et al. 1998, Anetor et al, 1999). This is probably why some nutritionists believe that current heavy environmental pollution has quite simply made the traditionally recommended daily allowance (RDA) for some antioxidants such as vitamin E is obsolete (Tolonen 1990). Vitamin E has been described as nature's master antioxidant (Packer, 1994). Vitamin E has been reported to reduce the toxic effects of the atmospheric oxidant gases including ozone. It has been described as the biological and environmental antioxidant (Menzel et al, 1972, Petering et al. 1977). Consequently some nutritionists take 40 times the current RDA to counter environmental pollution and attendant consequences (Tolonen, 1990). It appears desirable to recommend this to the general population now that the level of pollution is generalized and particularly in the industrial cities.

**Environmental Pollutants and Forest Decline**

The ill effects of environmental and ecological disorders are not only on human health, but on all living things (Last, 1987). The recently reported forest decline in the United States and Europe for a number of tree species (Gawel et al, 1996) illustrates the effects of environmental disorders on living things other than humans. Atmospheric pollutants from industrial sources, such as acids or oxidants, are thought to be at least partly responsible. Heavy metals have also been implicated since their deposition pattern was correlated with forest decline (Grill, 1987).

The concentration of phytochelatins have been used to show that metals are indeed most likely to be a contributing factor in the decline of forests in the northern United States (Gawel et al. 1996). Phytochelatins are intracellular metal-binding peptides like metallothionein for Zinc and Cadmium in animals and humans. They act as specific indicators of metal stress (Schat, Walf 1992, Grill et al 1988). Phytochelatin concentrations in red spruce, a species in decline are higher than that of balsam fir, a species which is not (Gawel et al 1996). Concentrations of phytochelain increase with altitude, as does forest decline. They also increase across the region in forest stands that show increasing levels of tree damage. The most likely explanation of all available data on the pattern of phytochelatin concentrations and the pattern in tree damage according to species elevation and geographic distribution, is that heavy metals are a contributing cause of forest decline in northern United State (Mandamanda et al, 1991, Devos et al, 1992).

Phytochelatin may thus indirectly serve as bioindicators of environmental pollution. Agriculture Scientists and Plant biologists evaluating such effect may corroborate human and animal data. This may emphasise the magnitude of the problem. Additionally forest decline as a consequence of environmental pollution may have economic consequences if economic trees and food crops are affected. The degree of photosynthesis on which Fauna so much depend will be impaired. This was probably why Oyesola (1998) observed that control and protection of the environment are not only matters of economics and politics; they are about personal, emotional and survival of individuals, societies and our planet as well.

**Free Radicals and Antioxidants**

Free radicals are chemical species with one or more unpaired electrons in their outer orbital. Our body normally produces them because they are normal by-products of metabolism. However, uncontrolled

generation of free radicals is destructive to the cells, tissues and organs. An understanding of free radical production due to external and internal sources and the intra- and extra- cellular defence systems which protect the cells against free radical toxicity is desirable in the face of continuous environmental disorders. Currently, most diseases including environmental disorders are linked with free radicals and their antidotes, the antioxidants (Slater, 1982, Tolonen, 1990).

Antioxidants not only support vital organs and systems through the detoxification process, but also curtail free radical activity free radicals damage underlies most degenerative diseases and heavy metal toxins have the ability to increase the production of free radicals within the body substantially (Ercal et al, 2001). Indeed most of the damage caused by heavy metals stems from the oxidative free radicals. With a heavy toxic load, or antioxidant deficiencies, uncontrolled free radical production occurs.

Antioxidants are defined as substances that, when present at a much lower concentration than oxidisable substrate may significantly delay or prevent its oxidation. They play crucial roles in mammals and plants in protection against the harmful effects of free radicals generated during aerobic metabolism or through the action of xenobiotics (Arias and Jakoby, 1976; Foyer, 1994). By efficiently scavenging these free radicals, they prevent damage to DNA and lipids. Maintenance of the body's abundance of antioxidant concentrations such as vitamin A, C, E and β-carotene (all derivable from agricultural produce – fruits and vegetables). The molecular structure of these compounds is such that they can readily transfer a hydrogen atom to reactive free radicals, thus eliminating their harmful effects. The resultant unpaired electron on the derivative of the antioxidant is so delocalized that it is also relatively innocuous.

Additionally antioxidants break the vicious circle which involves the decomposition of fatty acids and proteins, the creation of new free radicals and eventual cell death. Selenium, Zinc, Manganese, Ubiquinone (Q10), Vitamins A, C, E and some of the B vitamins, β-carotene, canthaxanthine, amino acids and other substances like certain drugs are effective antioxidants. The principal message of this report is that individuals and populations can protect themselves from decomposition and the ravages of environmental disorders by ensuring that they receive sufficient antioxidants. Fruits and vegetables are rich in vitamins which function as antioxidants. (RRI, 1995).

There is a growing awareness that the incidence of certain diseases, including cancer and coronary heart disease is related to diet. (Ames, 1983, McBrien and Slater 1992). The damage to DNA and lipids which precipitates the diseases can be induced by free radicals which in turn can be induced by environmental pollution (Shakman, 1974; Medeiros et al, 1983). These radicals are normally scavenged and rendered innocuous by cellular antioxidants, many of which are vitamins or enzymes depending on trace elements for their activity. Fruit and vegetables are a major source of these antioxidants, particularly vitamins C and E and the carotenoids. This explains why diets rich in these foods appear to have a protective effect against cancer and heart disease and many other disorders including infertility etc. Among the factors that influence cellular response and susceptibility to environmental agents, diet/nutrition has received increased attention in recent years (Chew, 2002). The intersetoral approach however, appears missing. While the modes of action are complex and multifarious increased oxidative stress is directly or indirectly responsible for causing and or oaggravating the adverse effects from exposure to a number of environmental agents (Chow, 1991).

**Cancer / Environmental / Genetic Components**

A recent study has demonstrated that the genetic contribution to overall risk for most common cancers is less than one – third ($^1/_3$); implying that environmental factors make up much greater proportion of total cancer risk (Lichtenstein et al. 2000). This finding to the general population implies that the majority of individual cancer incidence is environment dependent.

In families with single gene cancer – predisposition mutations, the genetic component of risk will be relatively much greater, however, such families are uncommon.

**Cancer from the Molecular Point Of View**

Much of the genetic variation among human populations is caused by subtle DNA alterations, called polymorphisms, that are shared by many people. These differences can result in altered protein expression or changes in protein activity that affect a person's susceptibility to carcinogens or cancer promoters in the environment and they may also contribute to the variability in individual responses to treatment. (Alteration in DNA can be modulated by antioxidant micronutrients Berdanier, 1998). A major goal of investigations into the polymorphisms and altered protein expression is to more accurately identify cancer in the earliest stages, predict which individuals are likely to develop cancer and how quickly their disease will progress and for cast whether a patient will respond to a particular treatment.

**Antioxidants and Health**

"Five (5) pieces of fruit a day" introduced by the

National Cancer Institute (NCI) (Havas et al. 1994; Subar et al. 1995), has become a catch phrase in health promotion. This phrase expresses the idea that antioxidants especially vitamin E and carotenoids found in fruit and vegetables, afford protection against diseases such as cancer and heart disease. This is supported by much epidemiological evidence especially from China (Blot et al., 1993; Li et al., 1993) of the association between low fruit and vegetable consumption and elevated incidence of cancer and heart disease. Though epidemiology is more popular it merely reveals association and casual links remain obscure. Molecular epidemiology, an approach which aims to examine the aetiology of disease in a more precise way by focusing on biomarkers of disease risk, rather than relying on the actual occurrence of disease might be preferable. Studies from China appear to support the antioxidant hypothesis (Chen et al., 1992). Evidence for the protective effects of ascorbic acid, carotene, retinol, tocopherol and selenium has been provided by ecological case control and protective studies (NRC, 1979; Helzlsayer et al, 1989).

The antioxidant hypothesis relating to cancer incidence was formulated on the assumption that oxidative damage caused by free radicals can have long term implications. Reactive forms of oxygen, such as hydroxyl radical can damage DNA (Halliwell and Gutheridge, 1989). When nucleotide bases are altered or destroyed, mutation (permanent changes in DNA sequence) can ensue, and if certain genes are mutated, cancer may result. Luckily, free radicals are usually scavenged by cellular or dietary antioxidants before they cause any harm when these are in adequate supply (antioxidants|). Normally any damage to DVA is generally repaired by cellular DNA repair processes. However, these defence mechanisms are not infallible and permanent DNA damage can occur if there are deficiencies in either components (Ames, 1983).

**Nutritional / Antioxidant Intervention**

Vitamin $B_1$ (thiamine) though not an antioxidant as such functions in a related capacity, in that it contains a sulfide thiazole ring which acts in a similar Manner as sulphur containing – amino acids from sulphur rich foods, such as garlic, onions, beans and Lentils which act as chelating or binding agents for heavy metals. It forms relatively inert bonds with the heavy metals in which form they are easily excreted from the body. Ascorbic acid a well known antioxidant, increases the turnover rate of toxic metals and reduce damage by scavenging free radicals generated by the toxins. (Buttram and PiColla; 2003). Glutathione, a sulphur containing tripeptide may be the most valuable in this respect (Buttram and PiColla, 2003, Kidd, 1997).

Nutrients, macro and trace minerals including calcium, magnesium, zinc, manganese, copper, selenium and iron given as supplements are of utmost importance in treating subjects, especially children with heavy metal toxicity for two reasons. First such children will almost invariably be deficient in these minerals, secondly these minerals especially calcium, zinc, copper and iron tend literally to push (due to competition) the toxic metals out of the body as they are replenished. Calcium and lead infact share the same metabolic pathway (Aub et al, 1940).

There is ample evidence supporting the consumption of antioxidant rich fruits and vegetables (at least 5 servings daily) to reduce the risk of cancer (Godwin and Brodwick, 1995). Given that fruits and vegetables are the main sources of the antioxidant, vitamins C and E, individuals who consume low amounts of fruits and vegetables are at greater risk of cancer, particular in environments favouring environmental disorders. This is a risk second only to the risk of smoking (this habit itself being a form of individual pollution. Accordingly, a comprehensive and universal programme of micronutrient support is probably the most cost effective and safest way of improving the general health of nations (Clayton, 2003) in the phase of unmatched environmental and ecological disorders. Fukushima et al (2001) have also recently drawn attention to the suppression of chemical carcinogenesis by water-soluble organosulfur compounds found in garlic and onions. They suggested that their increases intake may be of importance in cancer prevention.

The potential healthcare cost savings are enormous. The social implications of the prospective changes in public morbidity and mortality which may represent as many as 25 additional years of healthy middle and old age will be quite substantial (Clayton, 2003). This appears particularly relevant in the toxic world and disordered ecology of today's world.

**Nutrigenomics**

The molecular basis of chronic diseases remains elusive. Nutrigenomics promises significant improvement in the understanding of the molecular basis of chronic diseases including those arising from toxic metal or toxic chemical syndrome. Micronutrients owing to the role they play in gene expression are also important here.

The fundamental concepts of the field of nutrigenomics are that the progression from a healthy phenotype to a chronic disease phenotype must occur by changes in gene expression or by differences in activities of proteins and enzymes and that dietary chemicals (nutrients) directly or indirectly regulate the expression of genomic information (Haput and Rodriquez, 2004).

Alteration in dietary chemicals (nutrients) from environmental or ecological disorders can therefore produce altered expression of genomic which can lead to a form of chronic disease phenotype.

**The Role of the Agricultural Sector In Combating Environmental And Ecological Disorders**

The vital importance of agriculture and food production as part of the development imperative is well known. The role of the agricultural sector is already self evident from the discussion thus far. It is to mitigate the deleterious effects of ecological and environmental disorders by modifying food production with a bias for food crops that have counteractive effects on the adverse effects of pollution namely fruit and vegetables generally with special attention to areas of environmental pollution and ecological shifts. This is probably why the Chinese with high incidence of cancer of the oesophagus and other parts of the gastro intestinal tract (GIT) are now among the greatest producers and consumers of fruit and vegetables. While the current interest of the health sector is advocating increased consumption (Sorensor, et al. 1999) that of the agricultural sector should be increased production thus ready availability to stem the high cost of these foods in Nigeria.

There has been an increasing awareness of the need to give priority to meeting the basic needs of people for emphasis of food security, health and education to enhance capacities for sustainable development (Anyaoku, 1995). But in the last few decades there have been trends that give rise to deep and continuing concern. Globally increasing environmental pollution and ecological disorders (Shifts) pose newer challenges that in addition to meeting basic food and health needs, the health and agricultural sectors must collaborate to jointly combat the effect of pollution and attendant health problems which infact is an aspect of meeting health needs. This is probably in line with the call by Cortese (1992) for education for an environmentally sustainable future.

The health sector should help understand the effect of ecological and environmental disorders on human health and advice the makers of agricultural sector policy on strategies on how to ameliorate these disorders. The progressively stronger scientific and clinical recognition of nutrition and diet to health implies the need for education in different aspects of nutrient (NAS, 1989; US Depts. Of Agriculture, Health and Human Services 2000). The collaboration between the Agricultural and the Health sectors in this regard in the United States (US Depts. Of Agriculture, Health and Human Services, 2000) is worthy of emulation in the developing World. This will help to curb a number of chronic disorders emanating from environmental and ecological disorders.

**Environmental Disorders and Reproductive Dysfunction**

In a meta-analysis of 61 studies Worldwide Carlsen et al (1992) found a trend towards decreasing sperm quality and particularly sperm count and volume of seminal fluid, since the beginning of the 19$^{th}$ century for various reasons which include environmental disorders as a consequence of industrialization and increasing pollution.

It is believed that our world has been greatly polluted with petrochemicals (Oyesola, 1998) which has resulted in an epidemic of reproductive abnormalities including steadily increasing number of cancers of the reproductive tract, infertility, and low sperm counts. Persistent environmental pollutants such as polychlorobiphenyls (PCBs) produced from petrochemicals exert a variety of toxic effects in animals, including disturbances of sexual development and reproductive function.

Lead (Pb) a prime environmental pollutant and toxin is also a cause for concern in respect of its potential risk in reproductive performances (Anetor et al, 2001). It lowers sperm counts and it produces abnormal spermatozoa (Lacaranja and Popesca, 1975). Lead also causes loss of libido, reduced testicular weight, and decreased sperm motility (Hilderbrand et al, 1973). Females though less severely affected than males exhibit abnormalities in oestrous cycles, and in ovarian function (SCE1, 1977). Indeed the fall of the Roman empire was attributed to lead.

Current views suggest that the teratogenic effects of lead may at least in part be attributable to the action of Pb ions in inhibiting the metabolism or enzyme systems which involve micronutrients such as zinc, copper and iron (Landsdown, 1983). In classical biochemical studies, lead has been shown to inhibit the biosynthesis of haem by inhibiting the zinc-dependent enzyme, damino-laevulinic acid dehydratase and also ferrochelatase. These are well documented in the erythroid cells of the bone Marrow but may also be evident in other tissues known to be sensitive to lead such as the brain, the kidney and the heart (Landsdown, 1983). These observations imply that increased availability of the micronutrients indicated above may ameliorate the reproductive toxicity of lead and other environment toxins acting in a similar final pathway to precipitate environmentally induced reproductive disorders.

Added to these is the recent incompletely elucidated situation of endocrine disruptive substances (EDS) which has it greatest impact on reproduction impairment not only in human but also in birds, wide animals and fish (Colbron, and Clement, 1992, Gilvercman and Skakeback

1992, Danzo, 1997). The endocrine disruptive substances interfere with the synthesis, secretion, transport, binding action or elimination of natural hormones. The concentrations of (EDS) are magnified through bioaccumulation (Giwercman and Skakebact, 1992).

Environmental xenobiotics may also disrupt normal endocrine function by interfering with the binding of physiological ligands to steroid receptors and binding proteins whose synthesis is modulated by micronutrients (Danzo, 1997, Berdanier, 1998).

## CONCLUSION

With the large scale environmental and ecological disorders, millions of people are affected and it is impossible to remove everyone from the environment. Antioxidant micronutrient intervention appears a pragmatic way out. Micronutrients may indeed be molecular arsenals against cancer and other ailments associated with environmental and ecological disorders. The approach is proactive rather than reactive. We can no longer afford to ignore the effect of micronutrient on the health of humans and animals inhabiting contemporary environment. An effective intersectoral collaboration between the health and agricultural sectors is a challenge for a healthier populace and sustainable development.

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