POTENTIATION OF PESTICIDE MIXTURE TOXICITY UNDER DIABETIC ANDPROTEIN -MALNOURISHED CONDITIONS

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ABSTRACT

The development of chemicals for the control of pest has been one of the major landmarks in agriculture and medical developments of this country. Unfortunately these chemicals have caused global concern in view of their potential toxicity to biological system. Studies conducted on the toxicity of organophosphates and organochlorines indicated them to be potent toxicants and can induce marked biochemical changes in mammalian system. These pesticides when used in combination may potentiate the toxic impact in target as well as non-target living system. This aspect of pesticide toxicity is of great importance in the developing countries like India where protein-malnourishment and diabetes are rampant public health problems. Toxicity of these pesticides aggravated in protein-malnourished and diabetic animals.

KEYWORDS:

Diabetes, Protein- malnourishment, Organophosphates, Organochlorines, Toxicity

INTRODUCTION

A pesticide is any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any pest. By their very nature, most pesticides create some risk or harm to humans, animals, or the environment as they are designed to kill or otherwise adversely affect living organisms. At the same time pesticides are useful because of their ability to kill potential disease causing organism and control insects, weeds and other pests.

Studies show that pesticides can cause health problems, such as birth defects, nerve damage, cancer, diabetes and other effects that might occur over a long period of time. World Health Organization (WHO) estimates one million or more pesticides poisoning cases and 50,000 deaths every year globally. Recovering from the euphoria of the Green Revolution, India is now battling the effects of the extensively used chemical fertilizers and pesticides in the country's soil. The decade from 1980 to 1990 alone saw the area under pesticides in India increase a whopping 20-fold. Integrated Pest Management (IPM) practices have only now started to show a declining trend in the use of pesticides in India.

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Despite a comparatively low use of pesticides in India, the contamination of food products in the country is alarming. About 20% of Indian food products contain pesticides residues above tolerance level compared to only 2% globally.

The reason lies in non-judicious use of pesticides, lack of awareness and inadequate information dissemination amongst the farming community in India. The situation sets worse and alarming under protein- malnourishment and diabetic conditions; being rampant public health problems in developing countries.

It is now increasingly believed that just one class of chemicals does not cause many of the environmental and/or health problems that have come to light in the past 40 years. The usage of organochlorine and organophosphates in combination may cover broader spectrum but may potentiate the toxic effects of each other. The production, use and unfortunately, 40% of all pesticides used in India belong to the organochlorine class of chemicals, another 30% of the pesticides used belong to the organophosphate category. Most of these chemicals are banned in other countries and the rest are awaiting risk assessment reports before action can be taken. While DDT, HCH, Aldrin and Endosulfan were banned in the US and many other countries as early as in the 70's, they are still being used in India. In India banned pesticides continue to flow into the market despite government notifications because small farmers prefer them of their easy availability, low cost and wide spectrum of bioactivity.

This article presents the available literature on the important advances in knowledge on the toxicity of organophosphates and chlorinated hydrocarbons on the biological system and the potentiation in their toxicity under variable health stress conditions, with special reference to malnourishment and diabetes mellitus.

Krishnamurti (1980) has critically discussed the mechanism of action of organophosphate insecticides at the molecular level. Organophosphates inhibit or at least drastically reduce the speed of the regeneration of acetylcholine. Inhibition of acetylcholinesterase leads to accumulation of acetylcholine and prevents the transmission of nerve impulses across the synaptic gap(Yardan et al., 2013) and the resulting disturbance in electro-physiology causes loss of muscular co-ordination, induction of convulsions and death (Sultatos, 1994). Organochlorine insecticides act on the central nervous system, block a number of breathing enzymes and disrupt the functions of the liver, kidneys and other organs (Gruzdyev et al. 1983). Low protein diets are reported to influence insulin mediated glucose uptake by peripheral tissues and the ability of insulin to suppress the hepatic glucose output(Escriva et al., 1991)

Protein-Malnourishment and Pesticide Toxicity:

Recent experimental data have clearly established that nutritional factors play an important role in the metabolism and pharmaco-toxicological activities of xenobiotic (Campbell and Hayes, 1976). Different pesticides when used together, may potentiate the toxic impact, but the extent of toxicity may well be influenced by nutritional conditions (Bulusu and Chakravarty, 1992; Sharma et al., 1997; Kushwah et al., 2000). High protein diet proved successful in protecting rats

against parathion (Casterline and Williams 1971) and monocrotophos poisoning (Sharma et al., 1997,1998). Protein in the diet may help in the synthesis of cholinesterase (Chatterjee and Kaveeshwar 1991). Chronic exposure of pesticide in protein deprived animals caused hyperglycemia and hyperlactemia with a concomitant fall in hepatic glycogen and lactic acid. Drastic enzymic suppression under protein – deprived conditions was counteracted completely under protein rich dietary conditions (Benjamin et al., 2001). Chronic exposure of mixture of organophosphates and chlorinated hydrocarbons was studied on brain acetylcholinesterase (Benjamin et al.,2001), (S.K Mohajeri and Mohammad Abdollahi, 2010).Drastically suppressed the enzymic activity. However, chronic exposure to the protein deficient animals, clearly indicated derangement in the protein metabolism as a consequence of hepato-toxic effect of pesticides when used in combination (Benjamin N, 2004).

Diabetic Status and Pesticide Toxicity:

According to the Lancet study, China, India and USA are among the top three countries with a high number of diabetic population. India, often known as the diabetes capital of the world has been witnessing an alarming rise in incidence of diabetes (TOI, 2016). It has been attributed to the quality rather than quantity of dietary intake, life style and social stress, but above all the presence of a “thrifty gene” that has made Indians resistance to prolonged periods of starvation (Rao and Ahuja, 2002). WHO has identified one particular type of diabetes also which is ‘malnutrition related diabetes mellitus’ (MRDM) reported to be common in India and other developing countries.There has been increasing interest in the concept that exposures to environmental chemicals may be contributing factors to the epidemics of diabetes. (Thayer et al., 2012). Exposure to humans and animals show that various pesticides may contribute to the development of diabetes, especially at higher levels of exposureamong farmworkers and infants (Debost-Legrand et al., 2016). People exposed at very high levels of pesticides sometimes develop high blood sugar. One rodenticide, Vacor was banned due to its ability to cause permanent type I diabetes in humans (Diabetes and the Environment). Diabetes incidence is also associated with exposure to mixture of organophosphates and organochlorine (Starling et al.,2014). Pesticide may contribute to the growing rates of diabetes in Sub-Saharan Africa, because people in these countries may be more susceptible to the effects of pesticide due to variety of factors such as malnutrition(Azandjeme et al., 2013).Long term exposure of rats to monocrotophos resulted in glucose intolerance (Nagaraju et al., 2014). Pesticide intoxicationindicates the nephro-toxic effect of the pesticides that get aggravatedunder diabetic conditions (Benjamin N, 2004). Acute exposure to pesticide mixture declined the acetylcholinesterase activity in the brain slightly, but chronic exposure to the diabetic rats

inhibited the enzyme activity in the brain (Benjamin N, 2004). Muscular necrosis, hepato-toxic as well as nephro-toxic effects were evident in rats, being more aggravated in diabetic and protein-malnourished conditions (Benjamin N, 2004).

The present investigation was aimed to evaluate the extent of toxicity of these pesticides when used in combination and potentiation of the toxic effects under conditions of protein-malnourishment and diabetes mellitus.

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