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Chlorpyrifos and Profenofos Pesticide toxicity with reference to Grains crops

Bharat Kumar Vishwakarma, Nagmani Manikpuri and Hemant Kumar
Department of Chemistry, SNS. Govt. PG. College, Shahdol, M.P., India

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ABSTRACT: Pesticides are widely employed in agriculture, mostly to boost crop yields in order to meet the growing need for food and to addition to safety from pests and control insect-borne diseases. Increased pesticide use pollutes the environment and causes an overabundance of pesticide residues in food, which has always been a source of concern. The irrational administration of pesticides to growing crops is directly related to pesticide residue and crops. Pesticide residues in food have been linked to a wide range of human health risks, from short-term to long-term harmful effects.

Pesticide residue prevention efforts in poor nations are limited due to a lack of money and well-defined government rules. Pesticide residues can be reduced by adopting steps like using pesticides wisely, encouraging organic farming, utilizing natural and bio insecticides, and ensuring that pesticide-related legislation are properly implemented and amended. The purpose of this article is to discuss many elements of pesticide residues, particularly Chlorpyrifos and Profenofos, such as their accumulation in food, influence on human health, and preventive ways to mitigate their hazardous effects.

Key words: Pesticides, grain crops, Chlorpyrifos and Profenofos, toxic effect, human health

I. INTRODUCTION

Insecticides, fungicides, herbicides, rodenticides, molluscicides, nematicides, plant growth regulators, and other substances are all classified as pesticides [1]. Pesticides are classified as organochlorines, organophosphates, carbamic and thiocarbamic derivatives, carboxylic acids and their derivatives, urea derivatives, heterocyclic compounds, hydroquinone and nitro phenol derivatives, hydrocarbons, ketones, aldehydes and derivatives, fluorine-containing compounds, copper-containing compounds, metal organic and inorganic compounds, and natural and synthetic pyrethroids based on their chemical structure [Since the dawn of civilization, man's primary goal has been to strive to better his living conditions on a continuous basis.

One of the most important responsibilities that humans have undertaken is to provide respite from hunger. Second, our government prioritises the control of insects, weeds, fungi, and other economic or public-health problems [3]. Pesticides have continually demonstrated their value by increasing agricultural output, reducing insect-borne, endemic disease transmission, and protecting plantation, forests, processed wood products, homes, and fiber [4]. Pesticides are currently very significant in developing countries, particularly in tropical areas, as they seek to break into the world economy by exporting light of the fact fresh produce to countries with more temperate climates. These objectives, however, cannot be met without a greater usage of pesticides, particularly insecticides, herbicides, and fungicides [5].

Pesticides that are ideal must function selectively against specific pest organisms while causing no harm to non-target creatures. However, absolute selectivity is difficult to attain, and most pesticides are hazardous to humans and many other non-target creatures. Pesticide use causes a slew of problems for the ecosystem, including human health risks. Food products tainted with harmful pesticides have been linked to serious health problems in humans. More than 95% of sprayed pesticides and herbicides end up somewhere other than their intended target, such as non-target species, air, water, or soil [6]. When pesticides contaminate surface and ground waterways, they can harm water animals and plants, and also people's health [7].

Chemical pesticides have become more widely employed, resulting in environmental degradation and a slew of long-term health consequences. Pesticides have been linked to a wide range of human health risks, including short-term effects like headaches and nausea, as well as long-term effects including cancer, reproductive

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damage, and endocrine disruption [8]. Residues in food and vegetation are a direct outcome of pesticide application to field-grown crops, and to a lesser extent, pesticide residues left in the soil [9]. The purpose of this study is to examine many elements of pesticide residues, such as pesticide residue buildup in food grains, pesticide residue dangers to human health, and pesticide residue prevention techniques.

Profenofos and chlorpyrifos pesticides

Pesticides are essential for the protection of a variety of crops. Organophosphate pesticides are the most extensively utilised of the many types of pesticides used around the world. Profenofos O-(4-bromo-2-chlorophenyl) O-ethyl S-propyl phosphorothioate is an organophosphate insecticide that is widely used on field crops, vegetables, and fruits. This chemical is somewhat dangerous according to the WHO, place as toxicity Class II and residues have been identified in crops. The most common route for humans to be exposed to profenofos is through their diet. When it comes to agricultural fields, it's a no-brainer. Profenofos toxicity express in people and other living species in the environment, as well as with its biodegradation.

Chlorpyrifos is a broad-spectrum chlorinated organophosphate insecticide that is used to suppress a wide range of insects and pathogens in crops, fruits, and vegetables, as well as in homes and other settings. Chlorpyrifos poisoning has been linked to neurological problems, endocrine disturbance, and cardiovascular illness. Animal modelling has shown that it can also cause developmental and behavioural abnormalities, haematological malignancies, genotoxicity, histological aberrations, immunotoxicity, and peroxidation. Chlorpyrifos poisoning has also been linked to eye discomfort and dermatological problems. Chlorpyrifos works by blocking the reactive groups of the enzyme acetylcholinesterase, which results in negative effects on the neurological system. Chlorpyrifos has a short half-life in the body, but its active metabolites 3,5,6-trichloro-2-pyridinol Chlorpyrifos and chlorpyrifos-oxon have a longer half-life, although being similarly poisonous.

PESTICIDE RESIDUES IN FOOD GRAINS CROPS

Pesticide residue relates to pesticides or pesticide metabolic products that may persist in foods such as grains, vegetables, and fruits after they have been applied to crops. Many of these pesticide residues, particularly chlorinated pesticide derivatives, are bioaccumulative, meaning they can build up to dangerous amounts in the body and in the surroundings [10]. Persistent chemicals can spread across the food web and have been found in agricultural goods [11]. Insect and pests can reduce the quality and volume of grains and the products made from them. Pesticides are commonly applied to grains harvest and then after harvest to prevent them from injury or loss. Grain cultivation and storage frequently necessitate the use of a lot of water [12].

To avoid insect infestation, cereal grains are treated with posable pesticides such as organophosphates, carbamate, synthetic pyrethroids, and insect growth regulators in storage and prior to transportation [13]. When pesticides are administered correctly, the maximum contaminant level is the highest quantity of pesticide residue that can be legally allowed in or on food or feed. Pesticide legislation has been attempted to be harmonized by multinational parties. such as the European Union, the Codex Alimentarius Commission, and the North American Free Trade Agreement by defining maximum residue levels, although these limitations are still different globally. Pesticides in crops, meals, vegetables, and fruits in India are subject to maximum resistance due restrictions defined by the Food Safety and Standard Authority of India [14].

For different pesticides used to preserve wheat, the FAO and WHO established suggested residue limits [15]. Pesticide residues were discovered in 34% of cereal grain samples in a research conducted in Poland [16]. According to their findings, mixed cereal grains had the fewest quantity of crop protection product residues, while Triticum grains had the greatest level of pesticide residues. Organochlorine pesticide residues in cereal grains were found in a Nigerian research [17], including dichloran, dieldrin, endosulfan, heptachlor, lindane, and methoxychlor. A study of pesticide residue in cereals in Pakistan found that wheat had the greatest concentration of pesticides examined than maize and rice, with maize having a significantly greater concentration.

The physiochemical features of pesticide molecules, as well as diet, influence the formation of pesticide residues [19]. Contaminants in crops are common after harvest due to the use of insecticides during cultivation. Pesticides are used by most agricultural and commercial producers on multiple occasions during the growing season

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because they reduce toxins produced by food-infecting organisms, boost production, and are less labour intensive. According to a study, crops had the highest number of pesticide residues, with methomyl and imidacloprid being the most common. Methomyl is a carbamate insecticide that is restricted in use due to its significant human toxicity. Chlorpyrifos, fenhexamid, metalaxyl, and tebuconazole were among the additional pesticide residues discovered in crop samples [20].

Imazalil, thiabendazole, chlorpyrifos, group, orthophenylphenol, fenhexamid, prochloraz, cyprodinil, and boscalid were the most commonly identified pesticide residues. Pesticide residues were found in high concentrations in pears, grapes, citrus fruit, peppers, cucumbers, tomato, and carrots in Lithuania [21]. Pesticide residues were discovered in 72% of the samples in a Belgian research, and standards were violated in 6% of the samples [22]. Imported blackberries, strawberries, and other berries, but also mangoes, papaya, pepinos, bitter melon, peas, beans, eggplant, spinach, and other vegetables, were found to contain high levels of pesticide residues. Cabbage, beans, and leaf mustard were reported to have the greatest levels of pesticide residues in China [23].

Acephate, methamidophos, chlorpyriphos, monocrotophos, and quinalphos were among the insecticide residues found in grape market samples [24]. The residues of lambda-cyhalothrin in acidity lime lasted 20 days, and the greatest residues in juice samples lasted 10 days [25]. According to a research on pesticide residue content in vegetables, the risk to categories by season, with the winter season having the highest pesticide level in vegetables [26]. In some tests, the amounts of pesticide lindane surpassed the BIS guidelines by 140 times. Heptachlor, which is illegal in India, was detected in 71% of samples at levels 4 times greater than BIS guidelines. In a study, Chlorpyrifos levels were found to be 200 times higher than the BIS norm.

Pesticide residues impact on human health

Many pesticides work by disturbing the nervous system in order to kill the bugs. There is a lot of speculation that these compounds can harm people because their brain biochemistry is comparable in many different organisms [28]. There are epidemiologic studies that suggest a link between pesticide exposure from potential injuries, which is substantially higher than pesticide exposure from food consumed by the general public, and the prevalence of certain malignancies [29]. Although most people are not exposed to a significant amount of pesticides, many of the pesticides that are attached are lipophilic and also can bio-accumulate in the body.

The harmful effects of pesticides are determined by their toxicological qualities, residual levels, and human exposure to residues. Pesticide residues in cereals may not necessarily indicate that they are dangerous. To be toxic, residues must be present in such levels to be regarded hazardous [30]. By interacting to the enzyme acetylcholinesterase, organophosphate, organochlorine, and similar insecticides damage nerve activity, leading in paralysis and sometimes death [31]. They can cause meiosis, urine, diarrhoea, diaphoresis, lacrimation, central nervous system excitement, and salivation as acute consequences. Chronic exposure has neurotic and behavioural effects in volves. Pesticides can cause damages to the central and peripheral nerve tracts, cancer, allergies and hypersensitivity, as well as reproductive problems.

NEURONAL DAMAGE

Accumulation of acetylcholine at synapses after exposure to organophosphates causes quick and severe excitotoxicity and malfunctioning of cholinergic neurons in the brain. Overstimulation of muscarinic acetylcholine receptors can also throw off the balance of excitatory and inhibitory processes, resulting in neuronal excitotoxic lesions and respiratory depression [33]. Seizures can occur when glutamatergic neurons release too much glutamate, causing excessive calcium release in post-synaptic neuronal cells [34]. Seizures resulting from a cholinergic neuronal excitotoxic injury in the brain may play a synergistic role in the development of irreparable head trauma and long-term neurological and behavioural problems [35]. Organophosphate poisoning causes gradual brain damage and neuronal cell death, and therapeutic intervention to prevent the convulsions is ineffective [36].

Secondary neuronal damage is an indirect result of the initial lesion and a major contributor to neuronal cell death and neural loss in the injured brain, resulting in serious neuropsychiatric impairments such as memory loss, inability to focus, speech problems, motor and sensory deficits, and behavioural issues [37]. Extensive intracellular edoema, cerebral haemorrhages, intracellular calcium overburden, oxidative stress, and increased

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neuro inflammatory responses were all observed in the affected brain regions in the first few hours after organophosphate poisoning as a result of cholinergic neuronal excitotoxicity [38-42]. Lipases, proteases, kinases, hydrolases, and endonucleases are activated in potentially damaging metabolic cascades as a result of the increased calcium influx, halting protein synthesis and depriving cells of enzymatic or trophic factors needed for survival [43, 44].

OXIDATIVE STRESS

The principal mechanism of organophosphate toxicity has been shown to be the production of oxidative stress in subchronic or chronic organophosphate exposure [45]. Both acute and chronic poisoning with organophosphate chemicals causes oxidative stress in humans and experimental animals [46]. In organophosphate intoxication, hyperglycemia is one of the causes of oxidative stress [47]. Studies on chronic carbamate pesticide exposure as well as case reports of long-term exposure yield ambiguous results [48]. A review of the toxicity of carbaryl, a common insecticide, found a number of reversible neurobehavioral and neurotoxic impacts in vertebrates, all of which were linked to acute poisoning symptoms [49]. Carbofuran, a carbamate, has been shown to amplify oxidative stress in the rat brain by causing lipid peroxidation and lowering antioxidant defaces [50].

Developmental disorder as cancer

The cancer studies look into the dangers of consuming specific goods that include pesticide residues. Fish, water, seafood, and milk or other dairy products are examples of these consumables. In general, these investigations uncover a minor but statistically significant link between cancer risk and pesticide residues like dichlorodiphenyltrichloroethane and dichlorodiphenyltrichloroethane. Polychlorinated biphenyls, in particular, pose a higher risk to consumers. The levels of organochlorine pesticide residues were found to be considerably greater in cancer patients [51-53].

REPRODUCTIVE DISORDERS

The findings revealed that an increase in pesticides in the blood of vertebrates causes reproductive failure, and that food containing insecticides in excess of the allowed limit should be avoided for humans [54]. In men attending a reproductive clinic, eating fruits and vegetables with significant pesticide residues was linked to a decreased total sperm count, ejaculate volume, and proportion of morphologically normal sperm [55]. Pesticide exposure has been linked to lower fertility, early and late fetal loss, longer duration to pregnancy, spontaneous miscarriage, and preterm delivery in females, as well as genetic changes in sperm count, damage to the germinal epithelium, and altered hormone levels in males [56].

Preventive measures to reduce pesticide residues from grain crops

To avoid pests, insects, and weeds, different types of pesticides are employed in different nations for different types of crops. More pesticide-treated foods are being imported into multiple nations as a result of the rise of global trade. These global exchanges contribute to the spread of residues in other parts of the world, which is a public health risk. Pest and disease problems can be minimized, and pesticide residues in grain crops, vegetables, and fruits can be reduced, using a variety of ways [57].

ORGANIC FARMING

Eating organic foods rather than non-organic foods is one of the strategies used to lessen the influence of pesticide residue in food. Non-organic crops had four times the frequency of measurable pesticide residues than organic crops, according to established meta-analyses [58]. Organic food consumption has been shown to lower pesticide residues in meals [59]. Across locations and production seasons, organic crops exhibit higher antioxidant concentrations and lower pesticide residue incidence than non-organic crops. Antioxidant-rich foods should be consumed to minimize the impact of chronic disease by reducing oxidative activity. Increased consumption of antioxidant-rich foods protects against chronic diseases such as heart disease and some malignancies.

DIETARY PRODUCTS CLEANING

Washing is the second approach for reducing pesticide residue in food that has been described. Pesticide residue in food may be reduced by washing. Pesticide residues must be reduced by washing with water and other chemical solutions for household and commercial usage [61]. The effectiveness of pesticide removal washing procedures is determined by the washing solution, the pesticide's chemical characteristics, the surface area, the character of the food, the amount of time the pesticide is in contact with the product, and the pesticide's formulation and application method. Pesticides are usually trapped in the exterior wax-

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like layers but then travel inside to the, making pesticide washing and removal less effective [62].

DIETARY PRODUCTS PROCESSING

Processing techniques such as washing, peeling, canning, or cooking that the most of foods undergo before to consumption are an essential component in reducing any residues left on products at harvest [63]. Processes such as peeling, boiling, frying, fermenting, and grinding can modify pesticide residue levels in fruits and vegetables. Boiling can remove 60 percent of organophosphate residues and 25% of organo chlorines from food, reducing pesticide residues. Pesticide residues are said to be reduced by husking and submerging fruits and vegetables, particularly organophosphates.

RATIONAL EMPLOY OF PESTICIDES

Selection of appropriate pesticides, dosage rates, dilutions, refers to the frequency of treatment, treatment intervals, and technique of administration, as well as precautions and limitations, are all part of rational pesticide usage. Pesticide use that is rational can help to lower pesticide residues in foodstuff. In many circumstances, pesticides are unnecessary, especially when cultural or biological techniques are beneficial [64].

Application of pesticides and biopesticides

Bio-pesticides are biodegradable, leaving no toxic residues and are environmentally beneficial. Microbial pesticides, biochemicals generated from microorganisms, and other natural sources that give protection against insect damage are referred to as bio-pesticides. Some insect repellents can also help prevent pesticide residues from building up in food grains [65]. Natural insecticides, such as neem tree extracts and chemicals, are also effective at preventing pesticide residues from accumulating in food.

II. CONCLUSION

Pesticide residues accumulate in food grains and vegetables as a result of excessive pesticide use, which has been linked to a number of human health problems, including damage to the nerve cells, cancer, allergies and allergies, reproductive problems, and immune system disruption. Pesticide residues can be reduced by taking preventive steps such using pesticides sparingly, washing and properly processing food, practicing organic farming, using biological pesticides and bio-pesticides, and strictly enforcing and amending pesticide-related laws.

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