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A REVIEW ON-PESTICIDE RESIDUES OF FRUITS AND VEGETABLES

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ABSTRACT

Generally pesticides are used in agricultural practices to minimize the different pests in crops. Pesticide is any chemical substance or mixture of substances used for preventing, destroying, repelling, or mitigating the effect of any pest of plants and animals. They include herbicides, insecticides, rodenticides, fungicides, molluscides, nematicides, avicides, repellents and attractants used in agriculture, public health, horticulture, food storage or a chemical substance used for a similar purpose. It is also used as substances applied to crops either before or after harvest to protect the commodity from deterioration during storage and transport. This paper provides current information about pesticide residues of fruits and vegetables. In this paper Classification of pesticides, commonly used pesticides in vegetables, Current trends in analysis of pesticide residues, Effect of food processing treatments on pesticide residues in fruits and vegetables, Effect of prolonged exposure to pesticides on health are reviewed.

KEYWORDS: Classification of Pesticides, Commonly Used Pesticides in Vegetables, Current Trends in Analysis of Pesticide Residues

INTRODUCTION

Pesticide is any substance or a mixture of substances intended for preventing, destroying or controlling any pest including vectors of human or animal diseases unwanted species of plants or animals causing harm during or otherwise interfering with the production, processing, storage, transport or marketing of food, agriculture commodities (FAO, 2002).

Pesticides may be present in food, either as residues from the treatment of crops or at higher levels, as a result of contamination. Residues in food from agricultural handling may cause potential risk to the children due to cumulative exposure (Joanna *ET al.*2006).

Organophosphate pesticides were first discovered in 1954 but their general toxicity was not established. Tetra ethyle pyroph osphate (TEPP) was the first OP insecticide, which was developed in Germany during World War II as a by-product of nerve gas development. These are made up of an organic molecule to which phosphorous has been added. Commonly used organophosphates have included parathion, monocrotophos, malathion, methyl parathione, chlorpyriphos, diazin, didiclorvos, phosmet, tetrachlorvinphos, and azinphos methyl (Roy, 1997).

CLASSIFICATION OF PESTICIDES

The organic insecticides are split up into the following main groups.

Organophosphorous Compounds

Organophosphate (OP) compounds are the most widely used group of insecticides in the world.

Klein and Sarah *et al*. (2010) found that organophosphate exposure is associated with an increased risk of ADHD (Attention Deficit Hypersensitive Disorder) in children. Haydan *et al.* (2010) found that organophosphate exposure is associated with an increased risk of Alzeimer's disease.

Organochlorine Compounds (OC)

These are compounds made up of an organic molecule with the addition of chlorines. The downside to these types of insecticides is that they are very persistent. Some studies have shown that lindane has been used it is still active after a number of years. As a consequence these compounds are largely banned as they threaten the environment (Price, 2000).

Jaga and Dharmani (2003) reported that organophosphate pesticides have increased in use, because they were less damaging to the environment and they were less persistent than organochlorine pesticides. They were associated with acute health problems of workers who handle the chemicals, such as abdominal pain, dizziness, headache, nausea, vomiting, as well as skin and eye problems. Many studies have indicated that pesticide exposure was associated with long-term health problems such as respiratory problems, memory disorders, dermatologic conditions, cancer, depression deficits, miscarriages and birth defects.

COMMONLY USED PESTICIDES IN VEGETABLES

Monocrotophos

Monocrotophos is used to control a wide spectrum of chewing and sucking insects and also mites in a large variety of crops. Monocrotophos is thermally labile to decomposing exothermically at <55^0C. It is relatively stable at acidic and neutral P^H values but it is hydrolysed in alkaline solutions (Roberts *et al.*, 1998).

Acephate

Acephate is used to control a wide range of sucking and chewing pests in a large number of crops. Acephate is inhibitors of acetyl cholinesterase, primarily after metabolic conversion to methamidophos (Roberts and Huston, 1998).

Endosulfan

Endosulfan is a cyclodiene. A pure mixture consists of a 70:30 ratio of two sterio isomers of α- endosulfan and β-endosulfan. Technical grade endosulfan usually contains between 90-95%of the pure mixture. The two isomers have different physical properties and α- endosulfan is more toxic (Stringer and Johnston, 2001).

Carbofuran

Carbofuran is an odourless, white crystalline solid on exposure to heat breaks down in carbofuran, and then releases toxic fumes. It is also used for aphids, thripes and nematodes that attack vegetables, ornamental plants, sunflowers, potatoes, peanuts, soya beans, sugar cane, cotton, rice and variety of other crops (Dikshith and Dewan, 2003).

Chlorpyrifos

Chlorpyrifos an organophosphorous compound with an anti-cholinesterase mode of action is used extensively in a variety of formulations to control a broad spectrum of agricultural and other pestiferous insects. The compound is used not only in agriculture, but also to control mosquitoes in wetlands (Eisler, 2007).

Twelve most commonly used pesticides were selected to study residual effects on 24 samples of freshly collected vegetables. Most of the samples showed presence of high levels of malathion. DDE, a metabolite of DDT, BHC, dimethoate, endosulfan and ethion were also detected in few samples.

Samples of vegetables collected at beginning, middle and end of seasons were analyzed for organochlorine levels. Maximum pesticide residues were detected from cabbage (21.24 ppm), cauliflower (1.685) and tomato (17.046) collected at the end of season and okra (17.84 ppm) and potato (20.60) collected at the middle of season. OCP residue levels in majority of samples were above the maximum acceptable daily intake (ADI) prescribed by WHO, 1973 (Neela Bakore, 2002).

About 32% of the samples showed contamination with organophosphorous and carbamate insecticides above their respective MRL values (Kumari Beena *et al*., 2003).

Current Trends in Analysis of Pesticide Residues

An article from Delhi presents the development of a multiresidue method for the estimation of 30 insecticides, 15 organochlorine insecticides and six organophosphorus insecticides, nine synthetic pyrethriods and two herbicides and their quantification in vegetables (Mukherjee Irani, 2003).

Ueno *et al.* (2008) evaluated a multi residue method determination of pesticides in agricultural products by SCAN mode GC/MS coupled with three kinds of data base for 253 pesticides: relative retention time, mass spectranand caliberation curve (scan method). The detection results agreed closely with those of the SIM mode GC/MS method using caliberation standard (SIM-selected ion monitoring method).

Glucer *et al.* (2010) evaluated the organochlorine pesticide contamination in wheat from konya region. This region is the largest area of cereal production in Turkey. Chlordane isomers, methoxychlor, DDT and its metabolites, aldrin, beta-HCH, heptachlor and lindane have been found to be the highest organochlorine pesticide residues. In some of these cases, various organochlorine pesticide residues have been determined to be higher than European community maximum residual limits.

Effect of Food Processing Treatments on Pesticide Residues in Fruits and Vegetables

Agriculture is the backbone of the country and is given top priority in allocation of funds. The present agricultural technology relies heavily on the use of high yielding varieties which are responsive to heavy fertilizer application and high pest susceptibility**.** Pesticide residues are reduced by processing or household preparation stages such as washing, peeling and cooking (Dikshit *et al.*, 2003).

A pesticide residue in foods is currently a major public health concern in developing countries as well as developed countries. An environmental contamination is mostly due to widespread application of highly stable organochlorine insecticides. Pollution caused by organochlorine pesticides is more harmful as they are slowly biodegradable and persist in the ecosystem for a very long period of time. Most of the organochlorine pesticides are banned in developed countries but are still being used in India. The harmful residues that remain on edible portion of crops and the amount which reaches water bodies has become the great cause of concern. The problem is aggravating day by day as they move up in the food chain and being at the top of food chain and man is the most susceptible to them.

Fruit and vegetables form an essential part of the balanced diet. They are an important part of world is agricultural food production, even though their production volumes are small compared to grains. Fruit and vegetables are important sources of digestible carbohydrates, minerals, and vitamins, particularly vitamins A and C. In addition, they provide roughage (indigestible carbohydrates), which is needed for normal healthy digestion (Studman 1999).

The processes that mainly reduce pesticide residue levels without any indication of increase in the confidence intervals were blanching, cooking, frying, peeling and washing (Boon *et al.,* 2008).

Washing with available plain water commonly used to reduce the pesticide residue and also with solutions formulated from chemicals readily available in a household kitchen. The chemicals recommended for the purpose of removing residues are salt, baking soda, distilled vinegar and potassium permanganate (Krol *et al.,* 2000).

Vegetables, such as tomato, okra, onion, pepper and other perishable crops which deteriorate few days after harvest. This is mainly due to the high moisture content and inability to maintain physiological constancy. Therefore, vegetable crops need special attention to prevent all those losses taking place. High moisture content also contributes to the quality of deterioration and indirectly to a decrease in quantity.

Adequate processing methods have been shown to detoxify several vegetables that are ordinarily toxic in their raw state, including the more popular vegetables. The chemicals which are used to improve the quality, colour and shelf life of vegetables may lower the nutritive value.

The exact nutrient content of fresh vegetables off the shelf cannot be determined because of high degree of variation. Sources of variation include genetic potential, crop growth and cultural conditions, maturity at harvest, postharvest handling and storage conditions, and type as well as degree of processing.

Tomato consumption has been shown to reduce the risks of cardiovascular disease and certain types of cancer, such as cancers of prostate, lung and stomach (Canene-Adams et al., 2005)

Important components of vegetables include vitamins, particularly those that act as antioxidants. Antioxidant compounds, ascorbic acid (AA) and beta--carotene are present in the greatest quantity in vegetables. Beta-carotene has been identified as a potential anticarcinogen, as well as an antioxidant and vitamin A precursor (Sies and Stahl, 1995)

DDT AND ITS METABOLITES

They have been linked to altered sexual development in various species, to a decrease semen quality and to increased risk of breast cancer in women. The estrogen like effects may cause reduced bone mineral density. It impairs natural killer and T lymphocyte response Dichrloro Diphyl Dichloroethylene (DDE) and Dichloro Diphenyl Dichloroethane (DDD) in blood levels have been associated. Life time treatment of mice with DDT induced liver tumors and they included overtly metastasizing hepatoblastomas (Mathur *et al*. 2003).

Lindane

Lindane is absorbed through respiratory, digestive or cutaneous routes and accumulates in fat tissues. Treatment with 1-40 mg of lindane/kg of body weight disrupts testicular morphology, decreases spermatogenesis, inhibits testicular steroidogenesis, reduces plasma androgen concentrations and may adversely affect reproductive performance in males. In females lindane disrupts the estrous cycle, reduces serum estrogen and progesterone levels decreases sexual receptivity (Mathur *et al.* 2003).

Chlorpyrifos

Chlorpyrifos is one of the most widely used organophosphorus pesticides have been reported to be a developmental neuro toxicant specifically targeting the immature brain. Exposure to Chlorpyrifos resulted in adverse effects on brain cell development. Neonatal rats were found to be more sensitive to Chlorpyrifos than the fetal rats and animals exposed prenatally developed behavioral disorder in adolescence and adulthood. Chlorpyrifos is suspected teratogen. It initially affects the development of glia, which develop much later. Studies carried out to evaluate potential toxicological effects of Chlorpyrifos in rats showed that repeated exposure to sub threshold doses of Chlorpyrifos may lead to growth retardation, behavioral abnormalities and muscle weakness (Mathur *et al.* 2003).

The consequences of exposure to chemicals such as insecticides has lead to intellectual impairments, behavioral problems, spontaneous abortions and premature deliveries in the pregnant women (Lamphear *et al.,* 2005).

Developing knowledge about the toxicity of various chemicals identifying reliable resources for pesticide information and providing a common sense approach toward recommending the safest practical alternatives is necessary (Catherine *et al*., 2007).

Tarola *et al.* (2008) reported that different types of pesticides were used in agriculture, which are chemical substances and they are potentially harmful to the environment and subsequently to human beings through the consumption of pesticide contaminated food. The consequences of exposure to the chemicals such insecticides may lead to intellectual impairments, behavioral problems, spontaneous abortions and premature births in the pregnant women.

Future Strategies-Integrated Pesticide Management

Development of bio-pesticides and research in to genetically modified plants are the alternatives to decrease the use of synthetic pesticides for plant protection.

Singh and Dhaliwal (2000) developed an alternative eco-friendly organic farming technology for sustainable vegetable production. The bio-pesticide neemax proved equally effective to control the prevailing insect pests in all crops, compared to recommended chemical pesticide.

In India, the national program for organic production standard is needed to maintain eco friendly methods such as organic manure, bio-pesticides and bio-fertilizers. Jeya kumar (2011) reported that organic agriculture is the process of producing food naturally. This method avoids the use of synthetic chemical fertilizers and genetically modified organisms to influence the growth of crops. The main idea behind organic agriculture is zero impact on the environment. The motto of the organic farmer is to protect the earth resources and produce safe and healthy food.

CONCLUSIONS

It can be concluded that although pesticide usage was more than the recommended in fruits/ vegetables, pre-processing and cooking practices are the factors which were attributed to the reduction in the pesticide residue levels as they are safe for consumption

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