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A Study on Impact of Pesticides on Vegetables and Fruits

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Abstract--- *For food production, pesticides are commonly used to increase food security despite the fact that on consumers, they have negative health effects. Pesticides are also harmful to plants and most food crops, including vegetables and fruits, after washing and peeling, contain residues of pesticides. The pesticides are highly poisonous and these pesticides can lead to the death of humans and animals even in very small quantities, whereas exposure to a sufficient quantity of almost any pesticide can cause long-term disease. One of the most common ways of exposure to pesticides in consumers is through the consumption of food. Like other plants, during production and storage, vegetables and fruits are attacked by the pests and diseases that results in damage which decreases the yield and the quality. During the cultivation of crops, pesticides are used along with the other pest management methods to kill pests and prevent diseases in order to diminish the loss and sustain the quality of fruit and vegetable harvest. The purpose of this study is to explain the occurrence of pesticide residues in vegetables and fruits, primarily how they dissipated, influenced by the techniques of food processing and their risk assessment.*

Index Terms— *Pesticides, pesticides residue, vegetables and fruits, cropping, food processing.*

I. INTRODUCTION:

Pesticides are broadly used in the vegetables and fruits due to their vulnerability to insects and diseases. Since the middle of the last century, they have been widely used around the world for their diverse benefits [1]. They have been applied in animal production and agriculture to reduce pests. The word pesticide encompasses a wide range of compounds including fungicides, insecticides, herbicides, molluscicides, rodenticides, nematicides, regulators for plant growth, and others[2]. In the processing of vegetables and fruits, insecticides are used to combat diseases by fungicides and pests. These are applied directly to the crops and after their harvest some may still be present in the vegetables and fruits as residues. Because of their negative health effects, pesticide residues in vegetables and fruits are a main concern to consumers [3]. Ideally, the pesticide should be lethal to the target insects, but not to non-target species, including humans. They are found in both raw and processed produce. Although, in several studies, the method of food processing were found to significantly reduce the residues of pesticides in vegetables and fruits[2][3]. The utilization of pesticides has increased as they have rapid action, decrease the toxins created by organisms that invade food, and are less labor intensive than other methods of pest control.

Pesticides enter the atmosphere in a variety of forms (e.g. powders, aqueous solution powders, moistened powders

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and emulsion or spray concentrates). Pesticides play an enormous role in increasing the quality and yields of agricultural product [4]. It is true that most of the fungicides and insecticides are toxic substances, but when properly used, they are an essential input in the cultivation of vegetables and fruits to produce economically marketable products [5]. This excessive use, however, has sometimes been followed by the human and environmental hazards.

Many pesticide residues are found in all agro-ecosystem compartments, but perhaps the most real human threat is through the ingestion of food residues as vegetables and fruits[6]. Particularly some of these pesticides are persistent and are resistant to the microbial degradation. These can cause acute meiosis, diarrhea, urination, lacrimation, diaphoresis, central nervous system excitation, and salivation symptoms[7], [8]. Neurotic and psychological symptoms are involved in chronic exposure. Specific effects of pesticides may include allergies, cancer and hypersensitivities, reproductive disorders, destruction of the immune system, central and peripheral nervous system damage.

II. **FOOD PROCESSING**:

Like other foods, Vegetables and fruits go through food processing and culinary treatments before they are consumed. Various scientists have studied the effects of these food processing and culinary methods and found a decrease in levels of pesticide residue except in cases where the product is concentrated, such as frying, juicing and oil production[9]. Few toxic metabolites, particularly thermal processing, may be released during the processing treatments. Ethylenethiourea (ETU) is one of the widely studied metabolites arising from the thermal processing of dithiocarbamates[6], [9]. On the other hand, customers can still be urged to use those methods of processing which minimizes the pesticide residues. After processing, such processing factors (PF) are expressed as the pesticide concentration after processing divided by the concentration prior to processing. Several processing factors (PF) are accessible in public literature, while others are available only from registry bodies for pesticides[10].

The effect of vegetable and fruit processing is said to be affected by the pesticide's physico-chemical properties as well as the method of processing. It is not easy to find processing factors for a particular processing method and a class of pesticides in the literature[11]. These become critical if researchers want to carry out risk assessments for a population group of pesticides. An instance can be demonstrated by risk assessment of organophosphorus pesticides exposure in the diet of Dutch[1], [2], [4]. For a set of organophosphorus pesticide, the researchers could not find the common processing factor. However, the general processing factors for vegetables and fruits are extracted for washing, peeling and canning.

II.I. Pesticides Application To Vegetables And Fruits:

After pesticides are applied to the crops, they may contact with the surfaces of plant, which are exposed to the environmental factors such as sun and wind, and may be washed away during the rainfall. The pesticide may be absorbed by the surface of the plant and remain on the plant surface in the plant transport system. The pesticide may be subject to volatilization, chemical photolysis, and microbial degradation while still on the surface of the crop. All of these methods may minimize the concentration of the original pesticides, but may also introduce other metabolites in

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the crops. Pesticide volatilisation usually occurs immediately after field application.

The process is based on the pesticide's vapour pressure. High vapour pressure pesticides tend to volatilize quickly into the atmosphere while low vapour pressure pesticides stay on the surface for longer. The frequency of volatilization also depends on the factors such as temperature and wind speed. The greater the speed of the wind and the higher the temperature, the more pesticides evaporates. Photolysis occurs as the molecules of sunlight absorb energy resulting in the degradation of pesticides. The indirect reaction may also be caused by breaking down some chemicals by sunlight and their products, reacting with pesticides in turn and few pesticides can be degraded by the microbial metabolism. Microorganisms can use pesticides to divide them into carbon dioxide and other components as nutrients. Due to the difference among naturally occurring organic chemicals and structures of pesticides, microbes cannot assimilate them, but at reactive sites they may be altered[8]. The products produced may be less toxic or more toxic than the chemical parent.

II.II. *Determining Pesticides In Samples Of Vegetables And Fruits:*

In ancient times, the farmers were dependent on the utilization of techniques of organic farming and methods in their crop's cultivation. Natural methods like companion planting, crop rotation and composting were all used to ensure a safe and abundant harvest[6]. When commercial agriculture farming slowly gained fame over organic farming, the natural methodologies were replaced by those using chemicals for pesticides, fertilizers and weed killers. Vegetables and fruits are very nutritious and are formed as the main food product for the human consumption. Because of their short shelf life, they are extremely consumable. It is stated that these food products are contaminated with hazardous chemicals that are harmful and unsafe.

Despite substantial progress in developing methods for the preparation of samples for processing and the final determination of analytes, the study of pesticides in biological samples remains difficult for researchers. For the analysis of pesticide residues, a number of problems arises such as;

- low concentrations of pesticides in vegetables and fruit samples and,
- diversity and complexity of matrices in biological materials;

Furthermore, the target analytes must be separated from matrices and then enriched before the last determination can be carried out. The full process for determining residues of pesticides in biological materials is complicate and consists of the multiple stages described in Fig. 3[2]. It is of the utmost importance that the different phases of the analytical process and the method as a whole are checked to make sure compliance with the criteria that characterize the procedure and to determine its usefulness.

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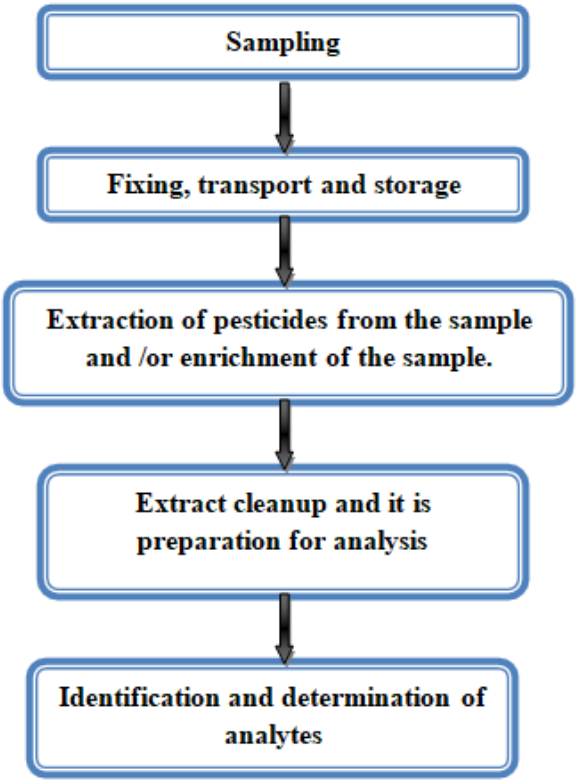

Fig.1: Main stages of analytical procedures for pesticide determination in fruit and vegetable samples.

II.III. Risk Assessment:

Risk assessment of chemicals is defined as a method for measuring or estimating the risk for a target organism, system or sub population, including the identification of associated uncertainties, following contact to a specific agent taking into consideration, the inherent features of the agent of concern and the characteristics of the particular targeted system. The risk assessment process mainly includes:

- Hazard detection
- Hazard characterisation
- Exposure assessment
- Risk characterisation.

Hazard Detection:

The first step in the risk assessment is Hazard detection, which includes the recognition of the nature and type of adverse effects that an agent is capable of causing in an organism, system or sub population as inherent. Recent regulations involve the detection of hazards before a pesticide can be licensed for use in agriculture farming or other areas. The information on the hazards posed by pesticides is therefore readily available for public use from the pesticide licensing bodies and on their websites. The pesticide hazard which is reported, includes the endocrine and reproductive damage, delays in neurodevelopment, cancer, immune system and respiratory distress. Studies are performed in

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research species (cells or animal, microbial) and the level of exposure is raised until it is caused by any adverse effects. The "no-observed-adverse-effect-level (NOAEL)" is the maximum dose of the pesticide that does not cause observable toxic effects on the test species and is measured in mg/kg of body weight per day. This is significant because it is used in either the "Acceptable Daily Intake (ADI)" or the "Acute Reference Dose (ARfD)" calculation.

Hazard Characterisation

Hazard characterization is the qualitative and whenever possible, quantitative description of the inherent properties of an agent or condition with the potential to cause adverse effects. Wherever possible, [25]this should include an assessment of the dose response and its related uncertainties. Characterization of the hazard requires matching the concentration of pesticide exposure to the ADI or ARfD[13], [23]. The ADI is the calculation of the quantity of material in food (mg / kg body weight / day) that can be consumed daily over a lifetime without significant health hazard to the consumer. ADI is estimated by dividing the NOAEL for animal studies with an uncertain factor of 100 to change into a safe level for humans. A factor 100 (10 x 10) used mostly to account for differences in species and individual inconsistency in sensitivity to chemicals[26]. ARfD is an estimation of the amount of a drug that can be consumed in food over a short period of time, typically one meal or one day, without any significant health risks for the consumer.

Exposure Assessment

Evaluation of the concentration or quantity of a specific agent enters a target organism, process or sub population for a given period at a specific frequency. In exposure assessment potential intake of pesticide residue is divided by body weight and compare to ADI or ARfD[25], [26].

Exposure = (pesticide residue concentration x consumed food)/body weight

The input data utilized in the exposure assessment arises from monitored field residue tests, food consumption surveys and regional pesticide control programs. Residue levels from pesticide controlling programs may not cover the entire supply of food, but they are always available in many countries and represent samples available to consumers[22], [24]. Targeted sampling data, however, can overestimate exposure as it is biased towards suspicious samples.

III CONCLUSION AND FUTURE ASPECTS

In pesticide residue studies, future work includes primarily strengthening the risk assessment of dietary exposure approaches and harmonizing data collection in as many countries as possible. Persons who spread pesticide should be adequately protected in homes or gardens. Food sold or donated (like food aid) must obey pesticide laws, with total residue limits in general. People who cultivate their own food must follow instructions for use when using pesticides and protect themselves when needed by wearing gloves and face masks. Through peeling and washing

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fruit and vegetables, customers can further restrict their consumption of pesticide residues, which also eliminates certain food-borne risks, such as harmful bacteria.

The aim of monitoring residues of pesticides is to protect the health of customers from their possible side effects. Above all, safe food should have an acceptable nutritional value and should contain the least amount of substances that could pose a risk to health. Different processing operations are implemented on vegetable and fruit crops to minimize the risk of pesticides on safety, reducing pesticide residues below the level of risk. Exposure to pesticides can cause a variety of neurological effects such as loss of coordination, memory loss, reduced visual ability, reduced stimulus response rate, reduced motor skills, altered or common behavior and uncontrollable mood. Certain potential health consequences include allergies, asthma and hypersensitivity, and exposure to pesticides is also correlated with hormone disruption, cancer, reproductive and fetal development issues. There is a need to aware consumers by the media.

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