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Popular Article

Pesticide Residues and Food Safety –Challenges and Regulations

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Abstract:

Feeding the expanding population is a difficulty, even though access to safe food is a fundamental human right. Given the present rise in their use, it is evident that inputs like pesticides are necessary to increase food production. Growing food output while maintaining residue levels below MRLs is therefore extremely difficult. When pesticides are used improperly, there are hazards of pest resistance, revival, secondary pest outbreaks, pesticide residues, environmental contamination, and health problems for humans. To lessen the dangers associated with pesticides, there are numerous approaches for mitigating residue. The unification of pesticide management policies is necessary to promote seamless commerce. In order to safeguard public health, it is critical to harmonize pesticide laws worldwide and enhance food safety procedures, as food systems are under threat from hitherto unheard-of threats.

Key Words: Pesticides, residues, challenges, regulations

Introduction:

Pesticide use is common in developing world, and demand for pesticides is rising as a result of the current food production system's emphasis on high agricultural and livestock yields. One method that developing nations have had to boost such yields is through the use of pesticides, which are composed of chemicals that can control pests or regulate fodder growth. Food safety has both potential and challenges as a result of the modernization of agriculture and the increase of livestock production to supply the growing global need for food. Due to these difficulties, food producers and processors have a greater obligation to guarantee food safety and stop food contamination before it reaches consumers. For the purpose of facilitating pesticide management options, all international forums such as the FAO, WHO, OECD, PAN, WTO, and international agreements could be extremely helpful.

In order to minimize yield losses and boost productivity and product quality, pesticide use is becoming more widespread worldwide as agriculture continues to improve. Currently, almost two million tons of pesticides are sprayed on crops annually throughout the world in an effort to boost yield and lower losses due to illnesses and pests. The United States of America was the world's largest pesticide user in 2020, according to the Food and Agricultural Organization (FAO) of the United Nations. The top ten countries in the world for pesticide use are Brazil, China, Argentina, the Russian Federation, Canada, France, Australia, India, and Italy. China's overall use of pesticides dropped dramatically, according to the FAO's 2022 update, which pushed China up to third place worldwide. The

overall use of pesticides has increased by almost 50% as compared to the 1990s, despite the fact that a plateau has been reached recently.

Challenges due to pesticide residue:

Among other vegetation, turf, water, and soil can all become contaminated by pesticides. Pesticides will not only destroy weeds and insects, but they can also poison fish, birds, beneficial insects, and non-target plants. Pesticide residues not only endanger human health and lead to concerns about food safety problems, but also seriously affect the export trade of different food products both from plant and animal origin. Large-scale pesticide use has become a significant problem in a number of exporting nations due to the discrepancy and lack of global harmonization of pesticide MRLs, as evidenced by the rate at which these countries fail to comply with the MRLs of the destination importing countries. In order to prove conformity with the necessary national legislation, inspection and sample are thus conducted in both the exporting and the importing nations. While exporting nations are supposed to adhere to the importing nations' permissible pesticide residue levels, it is frequently difficult to conduct this kind of monitoring in developing nations.

India has become a food surplus nation after gaining its independence. Before then, it was a food deficit nation. The Indian government has been working hard to encourage the export of both fresh and processed food items, and in order to help with this, it has developed a number of policies and programs in recent years. Indian food product exporters still have to deal with rejections and bans in foreign markets despite their diligent efforts; the majority of these are caused by a failure to adhere to food safety and health regulations. The primary causes of this non-compliance include the existence of pesticide residues that are higher than MRLs and prohibited by the national food law of the importing nation. Exporters (farmers and processing facilities) have lost revenue and/or profits as a result of rejection and/or prohibitions.

For ages, India has been regarded as the queen of the spice trade. It continues to be the world's largest exporter of these flavor-enhancing ingredients. However, Indian spices have recently made headlines for all the wrong reasons. Purchases of blended spice packets that were provided to Singapore and Hong Kong were apparently halted due to the discovery of pesticide residues; in the meantime, other nations, including the US, started looking into possible pollutants in Indian spices.

Regulations to control pesticide residue and maintain food safety:

Countries have different pesticide regulations in place to safeguard people and the environment. This heterogeneity suggests that each nation may enact laws defining permissible levels of specific pesticides in food and feed as well as limiting or outlawing the use of specific pesticides because of their unacceptable impacts on human health or the environment. Establishing toxicological endpoints, such as acceptable daily intake (ADI) and acute reference dose (ARD), based on experimental data is the responsibility of the Joint Meeting on Pesticide Residues (JMPR), an expert organization jointly created by the World Health Organization (WHO) and the Food and Agriculture Organization (FAO). The JMPR also suggests to the Codex Committee on Pesticide Residues (CCPR) that the maximum concentrations of pesticide residues (also known as maximum residue levels, or MRLs) in food and feed be taken into account. The Codex Alimentarius Commission eventually approved the suggested MRLs in food and feed that are thought to be safe for consumers. The most widely used standards for food safety are the MRLs, which offer

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a large margin of safety based on sound agricultural practices. But despite the general framework that the Codex offers, the MRLs vary greatly throughout nations.

The Prevention of Food Adulteration Act (PFA), 1955, governs MRLs of pesticide agrochemicals in food products in India. The Food Safety and Standards Regulations, 2010 incorporate the current MRLs for agrochemicals and pesticides listed in the PFA. MRLs for particular food commodities are classified according to chemical product. When there isn't a recognized MRL, Codex Alimentarius MRLs are used.

Strategies Aimed to Protect Human Health and the Environment from Pesticide Exposure:

The methods for preventing pesticide exposure and its harmful effects on the environment and human health have been steadily improving as a result of significant scientific advancements in the fields of chemistry, biology, and structure biology. These include looking for new pesticides, creating techniques for identifying and reevaluating the safety of pesticides already in use, and creating processes for pesticide breakdown into less harmful chemicals. Sustainable Use of Pesticides Directive (SUD), was the EU's 2009 policy for integrated pest management (IPM). By combining sustainable biological, physical, and other non-chemical techniques to manage pests, the IPM strategy reduces the risks that chemical products provide to human health and the environment. Chemical pesticides ought only to be used as a last resort, according to IPM. Instead, novel cultivation techniques like intercropping, crop rotation and diversification, stale seedbed technique, and non-chemical tools like seed coating, flaming, and beneficial microorganisms should be used, along with competitive plant material like resistant cultivars and certified seed.

Gas chromatography (GC), high-performance liquid chromatography (HPLC), and chromatographic techniques combined with mass spectrometry (MS) detectors are examples of instrumental techniques used in traditional pesticide detection methods. These techniques offer a wealth of qualitative and quantitative data on residues with a high degree of accuracy. A straightforward, dependable, and reasonably priced method for predicting soil composition and the absorption of OPs such methyl parathion, phoxim, and chlorpyrifos is near infrared spectroscopy (NIR). Furthermore, a great deal of work has gone into creating microfluidic paper-based analytical devices (μPADs), which can be used for continuous testing, particularly in developing nations, and are an affordable substitute for highly sophisticated instrumentation in analytical applications for food and water monitoring.

Conclusion:

The entire ecosystem that surrounds food production must be taken into account in order to create a sustainable agricultural and food system. To safeguard human health, it is imperative to enhance and unify methods worldwide for food safety and food quality in addition to implementing suitable agricultural management practices. To control food pollutants, a comprehensive strategy including the whole food production chain should be implemented. Furthermore, a number of factors, including economics, demography, and climate change, have an impact on the food-producing systems from farm to fork, which could lead to new concerns for food safety and negatively impact human health. To develop sustainable agriculture and guarantee a just and sustainable food system that does not leave anyone behind, it is necessary to embrace cutting-edge technologies, promote sustainable practices, and foster information exchange on a worldwide scale.

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